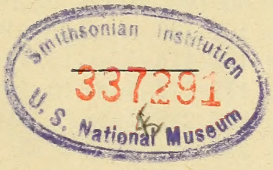
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VOLUME 36, 1946



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ETHNOLOGY.—*Mixed bloods of the Upper Monongahela Valley, West Virginia.*[1]

WILLIAM HARLEN GILBERT, JR., Library of Congress.

We are accustomed to think of West Virginia as a racially homogeneous State populated by Old Americans of English, Scotch, and Scotch-Irish descent with an additional contingent in recent years of Poles and Italians in the mining areas. It may come as somewhat of a surprise to many to learn that there exists in the northern counties of the State a racial island of mixed bloods, known locally as "Guineas," numbering several thousand persons. The origin of this mixed race is unrecorded, and the relative proportion of white, Negro, and Indian blood entering into its makeup is difficult to ascertain. The main seat of this people is in northern Barbour County and southern Taylor County, but small groups are to be found in over half a dozen adjoining counties and in Garrett County, Md. From their homes in the hill country many have gone in recent years to the factory cities of West Virginia, Ohio, and Michigan in search of economic opportunity and social betterment.

It is difficult to find a completely acceptable term to designate these mixed people. Stigmatized by white public opinion as a sort of outcast group, they dislike and resent any designation used by outsiders for themselves. They especially resent the terms "Guinea" or "Guinea Nigger," which are most generally applied to them by their white neighbors.[2] There are several possibilities in explaining the origin of this sobriquet.

An educated member of this group is said to have worked out a genealogy for them several years ago in which he claimed that an English nobleman went to the Guinea coast of Africa in the early days (possibly as a remittance man), married a native Negro woman, and produced a large family of crossbreeds. Later some of these descendants came to America and became the ancestors of the "Guineas." Hu Maxwell, in his *History of Barbour County* (pp. 310–311), asserts that the mixed bloods of that county are called "Guineas" under the mistaken notion that they are Guinea Negroes. They are said, however, to have claimed for many years a descent from one of the Guineas (British, French, or Portuguese) in Africa or from one of the Guianas (British, French, or Dutch) in South America, and that their blood was native Negro or Indian.

[1] Received December 4, 1945.

Many suggestions concerning the Guineas were collected in correspondence with persons interested, notably Mrs. Eva Margaret Carnes, of Roanoke, Va.; Mrs. W. H. Conaway, librarian of Marion County, W. Va., at Fairmont; and Mrs. Howard Grant, of Philippi, W. Va. Mrs. Grant kindly made available extensive genealogical material on the Guineas collected by her late husband. In addition, considerable material was gleaned from the census schedules at the National Archives and at Suitland, Md. In November 1945 a short field trip was made to Philippi and Grafton, W. Va., and extensive interviews were had with W. M. Watkins, attorney of Grafton; Vergil Rohrbough, superintendent of schools in Taylor County; E. A. Hunt, superintendent of schools in Barbour County; Charles W. T. Lockard, editor of the *Grafton News;* V. C. Willhide, of Grafton; as well as a number of the Guineas themselves. Finally, full credit must be given to the steady cooperation and unfailing enthusiasm of Philip S. Proctor ("Chief" Turkey Tayac), of Washington, D. C., to whose initial suggestion this research is due.

[2] In the following discussion although the word "Guinea" is employed without quotes it is not meant to condone an approbrious epithet. Rather it is used for lack of any other single term to designate these people.

JAN 25 '46

It is worthy of notice that during the nineteenth century the name "Guinea" was applied as an epithet to things or persons of foreign (especially Italian and Polish) and uncertain origin in many parts of northeastern United States (Mencken, 1936, p. 295, and *Dictionary of American English* 2: 1193). The term was also applied to Italians of the laboring class because of an incident which took place in early American history when English pennies (jestingly called "Guineas") were circulated in North America and Italian help would receive them freely and even save them as valuable coins. From the coins the term was transferred to their recipients (Roback, p. 37). Undoubtedly there is some linkage of the West Virginia mixed bloods with Italians in the popular mind because the two races are frequently said to intermarry rather freely.

The term "Guinea" does not seem, however, to have any significance in relation to the appearance of the mixed bloods, even though "Guinea Negro" has generally meant a very black member of the African race, and it probably has no reference to the yellow-colored gold pieces made from Guinea gold. The mixed bloods are certainly not black, nor can their color be adequately described as yellow. Much more to the point is the locality idea, a vague tradition of a place called "Guinea" from which these mixed people spring. It is said that the name "Guinan" or "Guinea," locally pronounced "Guinny," has long been applied to an area northwest of Philippi in Barbour County where these mixed people are centered. This area, also known as "Chestnut Ridge," was regarded by the whites as lowering the value of property in the adjacent parts owing to the nature of its inhabitants.

In Gloucester County, Va., there is said to be a section called "Guinea Neck" inhabited by a peculiar people, isolated by the coastal land formation. It is possible that the ancestors of the Guineas may have migrated from some such a region westward to Berkeley or Hampshire County in Virginia, where we first hear of them from the census records.

It must be admitted, when all is said and done, that none of these theories of the origin of this term is quite satisfactory, and we are just as much in the dark as before so far as a real etymology of this name is concerned.

There are several other terms sometimes employed to designate the Guineas. One of these is "West Hill Indians" from the community of West Hill, which is their principal center in Taylor County at the present time. Formerly the term "Cecil Indians" was heard, derived from the community of Cecil, now flooded by the Tygart Reservoir. Since many of these people lived near the Grafton & Belington Railway (or G. & B. Railway) and traveled on this line extensively, they were sometimes referred to as the "G. and B. Indians." Sometimes the Guineas employed the circumlocution "Our People" to designate their own kind or again the name "Maleys," referring to the commonest surname (Male) among them.

The family names of the Guineas are limited in number and are the most important items for identification of members. The characteristic names are Adams, Collins, Croston, Dalton, Dorton, Kennedy, Male, Miner or Minard, Newman, Norris, and Prichard. Of these by far the most frequent in occurrence is Male. The name Croston is next in frequency. The Males, who also spell their name as Mayle, Mail, and Mahle, trace their descent back to an ancestor who was said to have come over from England during colonial times. One observer thinks that there may be some connection between the Males and the Malay Race. It is said, moreover, that in the Male clan the white and Indian blood is much more prominent than the Negro. The Crostons, who have also spelled their name Crosten, Chroasten, Croaston, and Crostin, claim to be of Dutch descent and trace their ancestry back to Hampshire County, Va., along with the Males.

There is nothing singular about the personal names of the Guineas, but it is worth noting that nicknames of a sort are frequently applied, such as "Pizen John," "Screech," and "Whistling George." As

in many other groups some given names recur again and again in certain family lines over several generations. The importance of names will be mentioned again in a later context in this paper.

Before proceeding further with a description of this peculiar minority it would be well to note the natural conditions of the geographic environment of these people and how these influences have shaped their manner of life. Barbour and Taylor Counties are located in the northern part of West Virginia along the axis of the Tygart River, a branch of the Monongahela. Barbour County is less rugged than the mountainous counties to the east and south, although there are a few cliffs of some boldness along the watercourses. To the eastward are Laurel and Chestnut Ridges, which sink into hills with rounded tops in Barbour. There are no wide valley areas in Barbour, however, and the level lands are to be found for the most part on the ridges or uplands. In the bottoms along the Tygart and its branches the "Great Laurel" (*Rhododendron maximum*) formerly grew most luxuriantly. This plant flourished especially where cool and shady glades prevailed and often covered large areas with impenetrable laurel thickets. In the early days these thickets were the retreat of wild animals and a great barrier to the hunter. Since the Tygart flowed northeastward through the center of the county and had numerous branches running out at an angle from its bottoms, it furnished an ideal hiding place for the various refugee families from whom the Guineas are believed to have sprung.

Taylor County is similar in geographic character to Barbour. Lying at some distance to the west of the Allegheny ridges, its surface is of an irregular type, with numerous rounded hills. In large areas the land is comparatively level, however, and easily cultivated. As in Barbour County the Tygart River flows through the center of Taylor County but in a northwesterly direction, dividing it into two almost equal parts.

Between Barbour and Taylor Counties the Tygart River executes a change of direction, from a northeasterly to a northwesterly course, and in doing so forms on its left bank a loop or horseshoe-shaped peninsula called "the Narrows." This loop of land, surrounded on three sides by the glades of Tygart River and on the fourth or western side by equally impenetrable thickets of laurel, served as an ideal place

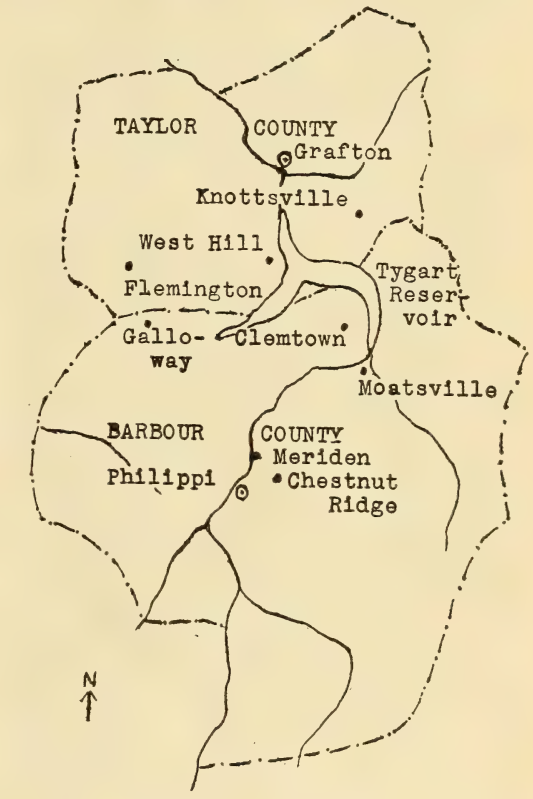


FIG. 1.—The chief communities in the mixed-blood areas of Barbour and Taylor Counties, W. Va.

for the hiding of runaways and refugees of all kinds. So isolated was this peninsula that even as late as 1880–1900 it was accessible only on horseback.

Not far to the south of the Narrows in Barbour County ran the old Indian Trail called "Horseshoe Run Trail," which started from the region of the Northern Branch of the Potomac in Maryland and ran across the Cheat River, up its Clover River Branch, crossed the Tygart slightly to the north of Philippi, and then con-

tinued westward into Harrison County (Hu Maxwell, 1899, map). Along this trail bands of Shawnee, Cherokee, Delaware, Hurons, and other tribes made their way in going across the central Alleghenies in the Colonial period. The natural game refuge in the Narrows not far off to the north along the Tygart could not have failed to attract the attention of hunters who were traveling this trail.

A considerable period of isolation must be assumed to account for the long-continued inbreeding which has characterized the Guineas for a number of generations. Before the 1840's Harrison County comprised all the area west of the Tygart, and Randolph County all the area to the east. In both of these counties Guinea family names began to appear about 1815 and to increase with the formation of Barbour County in 1843 and Taylor County in 1844.

Originally hunters and farmers on the ridges, the economic life of the Guineas expanded with that of the region in which they grew. They began to cultivate wheat, buckwheat, corn, hay, and orchard crops such as apples. Dairying, as well as poultry and cattle raising, became frequent. Garden vegetables were raised also. The predatory industries such as lumbering (in the oak, poplar, maple stands) and coal-mining engaged their labors. The building of the Baltimore & Ohio Railroad and other rail lines employed these people, along with Irish and other immigrant contingents. Some hauled coal while others became domestic servants in homes of nearby whites. Some became hucksters on market day, selling blackberries or other produce in nearby towns. In the coal mines the Guineas often worked in gangs made up of their kind. There was undoubtedly considerable contact with the Irish at one time. In the mines of Marion County they encountered at a later date the Poles and Italians of the New Immigration.

As many left the ancestral hive and settled in cities they took up occupations of various sorts and took on new names. In Ohio they settled near Canton, Zanesville, Athens, Chillicothe, Sandusky, and Akron, while some went even as far as Detroit. In these localities their work varied from gypsum works at Sandusky to gardening in the suburbs of Chillicothe. Migration back and forth into Ohio seems to have been going on from 1880 or earlier.

In Grafton, county seat of Taylor County, the Guineas were almost unknown as a group until recent years. Only once a year, on Memorial Day, did any large number come into town and that was on the occasion of a ball game. Since the building of the Tygart Dam in 1937 and the formation of the Reservoir, which flooded out large areas of their original domain, they have moved increasingly into the suburbs of Grafton, especially Blueville. Grafton restaurants and barber shops have now occasionally put up signs bearing the inscription "white patronage only," and color classification of the mixed bloods has bothered the hospitals and schools.

In Philippi, the county seat of Barbour County, the Guineas have been known from the very foundation of the settlement and were said to have been among the first settlers of the vicinity (1780). The chief settlements in this county are at Chestnut Ridge Community northwest of Philippi, at Meriden nearby on the Tygart, around Moatsville, Lick Run, Buchanan, Galloway, and Clemtown. Clemtown is in the central area of the Narrows. Almost all the Guineas are located in compact masses as small landholders on the ridges in the central and northern parts of the county.

In Taylor County the chief centers are West Hill to the south of Webster, Knottsville, and the vicinity of Flemington. The flooded area around Cecil, now occupied by the Tygart Reservoir, was also a former center. Most of the Guineas are in the southern part of Taylor County, but with the flooding of large areas in 1937 many scattered to other parts, thus giving rise to school troubles. In Marion County coal towns these mixed bloods are said to live in the less-favored parts of town along with the foreign born and the Negroes. The Guineas, however, have not gone to the city and industrial areas to the same extent probably as the West Virginia Negroes.

A number of other counties in northern West Virginia have small groups of Guineas. These are Monongalia (to the north around Morgantown), Grant, Mineral, Preston, and Tucker to the east, Wirt to the west, and Braxton and Randolph on the south. At Big Island Run in Wirt County there has long been a group of the Male family, rather dark in color, who were widely respected by their white neighbors for their industry and honesty. This colony has decreased much by migration in recent years. In Garrett County, western Maryland, the Guineas long had a small colony whose significance will be mentioned later.

As in all cases of unusual little groups of isolated peoples we are constantly met with the query, "What do they look like?" This is a question much easier to pose than to answer. From the accompanying photographs of Guinea school children it may be seen that although there is a considerable range in variation none seem to exhibit the marked features of the Negro nor for that matter of the Indian. Most appear to be of the classification of "Near Whites" or what in the West Indies is called the "Mustee" type. In fact, the Guineas do pass for whites outside of the communities where they have long been known.

Hu Maxwell, in the work previously referred to, speaks of them as "partly-colored people" and says that they vary in color from white to black, often possessing blue eyes and straight hair. According to another observer a single family of brothers and sisters may range from the blackest Negro to a blonde, blue-eyed, fair-skinned person, with all the shades in between. Some are perfect Negroes, while others have a marked Indian look. Most of the neighboring whites seem to regard the Guineas as mulattoes, while a few, noting the angular facial features and the hawk-like eye and nose, will concede an Indian element. Several informants commented that the Guinea women seemed to be either very ugly or very good looking with few in-betweens.

There can be little doubt that the Guineas, in common with the Wesorts of southern Maryland and the Croatans of North Carolina, are another example of the triple racial admixture of Indian, Negro, and white to be found in a number of places in this country where circumstances have favored their development. Only a detailed anthropometric analysis at some future date will yield the evidence for physical typology and the relative proportions of each group. Several of the Guinea genealogies refer back to full-blood and half-blood Indian ancestry, but the entry of Negro blood into the group is not recorded.

According to local white opinion the habit of inbreeding has weakened the Guineas. Several informants mentioned the deformities of the joints, especially of the arm and leg joints, as occurring at birth among them in a number of instances. Among other defects mentioned as occurring are bad hearing, poor sight, harelips, humpbacked conditions, and mental deficiencies and aberrations. In the line of diseases tuberculosis and typhoid fever are given a prominent place.

The size of the family is said to be above average. One observer mentioned three families in his neighborhood who had fourteen or fifteen children each. A family size of six or seven children is thought to be common within recent years.

The numbers of the Guineas are not subject to easy estimate. Hu Maxwell asserted that at the time he wrote (1899) they totaled 1,000 in Barbour County alone. If this figure be accepted as a conservative estimate, it must be admitted that since that time their numbers must have increased considerably in the county. It is thought by local informants that between 500 and 800 adult voters were of this race in Barbour County during 1944 and that this ought to represent a total population of 3,000 to 4,000. An additional 500 voters in Taylor County of this race would add perhaps 3,000 more, bringing the total for the two counties to a possible 7,000. To this aggregate must be added an unknown number scattered in other counties of West Virginia, Ohio, and Michigan. It is probably safe to say that the total number of the Guineas is somewhere between 7,000 and 8,000.



FIG. 2.—Members of Male, Croston, and other families in Barbour County, W. Va.

Some light may be thrown on the numbers question from Table 1, giving the population by race in Barbour and Taylor Counties from 1850 to 1940 (*Negroes in the United States 1920–1932; Negro Population in the United States, 1790–1915*). In a rural county such as Barbour it seems unusual to perceive such a marked increase in Negro population from 1920 to 1940. This taken in conjunction with the relative proportions of free Negroes and slaves and of blacks and mulattoes in 1910 would indicate something of the growth in numbers of the Guineas. In Taylor County conditions are reversed and the Negro population seems to outrank the Guineas in numbers.

TABLE 1.—POPULATION BY RACE OF BARBOUR AND TAYLOR COUNTIES, W. VA., 1850–1940

Year	Barbour County				Taylor County			
	Whites	Free Negro	Slaves	Total	Whites	Free Negro	Slaves	Total
1850	8,670	222	113	9,005	5,130	69	168	5,367
1860	8,728	135	95	8,958	7,300	51	112	8,958
1870	10,312	386	...	10,698	9,024	343	...	9,367
1880	11,413	457	...	11,870	11,056	399	...	11,455
1890	12,204	498	...	12,702	11,785	362	...	12,147
1900	13,390	808	...	14,198	14,553	423	...	14,976
1910	14,937	920*	...	15,857	16,025	527	...	16,532
1920	17,208	820	...	18,028	18,099	641	...	18,740
1930	17,657	971	...	18,628	18,391	722	...	19,113
1940	18,651	1,218	...	19,869	19,341	578	...	19,919

* 71 black and 849 mulatto.

According to the 1930 census only 33 percent of the "Negro" (i.e., nonwhite or mixed) population of Barbour County between the ages of 7 and 13 years were attending school. This contrasts with the West Virginia average figures for these age groups in the "Negro" population of 93.5 percent for that year and a county range within the State (outside of Barbour County) of 89 to 100 percent "colored" attending school. The same 1930 census gives a figure of 32.3 percent illiteracy for the "Negro" population of Barbour County, which is the highest in the State of West Virginia for that year. The preliminary figures for the 1940 census showed 97.7 percent of the "Negro" population of Barbour County between the ages of 7 and 13 attending school.

The school question regarding the Guineas has been an acute one for a number of years in both Taylor and Barbour Counties. According to West Virginia law white schools are to be separate from colored. For at least 30 years the Guinea children have been attending schools separate from the white. At the present time there are two such schools in Taylor County, a two-room building at West Hill and a one-room structure at Mount Airy, southwest of Knottsville. In Barbour County there are five or six such schools, at Prichard, Lick Run, Buchanan (Sutton School), Meriden (Hanging Rock School), and two at Chestnut Ridge.

School troubles have developed in both counties from time to time over the segregation issue and the classification of these schools as "colored." Apparently, no Negroes attend these Guinea Schools and there are several Negro schools in the two counties also. The following citation from the *Grafton News* of September 15, 1944, will explain something of the situation faced in Taylor County:

> Another problem . . . is the matter that concerns the failure to open the Mt. Airy one room colored school. Although the school was scheduled to open, its teacher, Earl G. Mayle, failed to open it Wednesday, September 6, when the other schools of the county began the current term.
>
> From the information available it appears that the residents of that community objected to sending their children to a school that was designated as a colored school. Apparently fearing that some difficulty might develop over the matter Mayle failed to open the school and this week tendered his resignation to the Taylor County Board of Education. Mayle had been the teacher at Mt. Airy for a number of years.
>
> The enrollment at Mt. Airy school, which is located in Knottsville district, last year was 18 pupils. Unofficial observers have it that only seven or eight children reported for school on the opening day, with the other children presumably being kept home by their parents.
>
> According to stories reaching Grafton there appears to be an organized movement, on the part of the parents, objecting to their children attending a school designated as a colored school.
>
> No indication has been made as to what steps the board of education will take toward opening the school or attempting to settle the pertinent question as to whether the children of the many families of mixed or unknown races which reside in that section must attend a colored or white school.

Much of the recent school problem in Taylor County has been due, it is claimed, to the building of the Tygart Dam in 1937 and flooding of area formerly inhabited by many Guinea families with consequent scattering to other parts of the county. Here the children were faced with trouble when they tried to enter the white schools.

In Barbour County there has been considerable trouble where white school administrators have occasionally failed to deal with the problem intelligently. It is said that over 20 members of the Guinea group were in jail at one time over failure to send their children to school. The teachers in the Guinea schools have been mulattoes and Guineas. Within the past year two schools have been burned down by persons unknown. One of these was a new school with much of the latest equipment. A number of court suits have been initiated to determine whether the Guineas were white or colored. Factionalism among the Guineas themselves is blamed for some of the school troubles in this county. One faction is said to desire the monopoly in the use of one school over another.

The religious affiliation of the Guineas appears to be almost entirely Protestant. Many are members of the Free Methodist denomination, while others belong to the United Brethren and the Pentecostal Faith. In Barbour County the major groups among the whites are the Methodists and United Brethren, with the Baptists ranking far behind in numbers. The Negroes of the county, however, appear to be mainly Baptist. In Taylor County, on the other hand, the Baptists are in a majority among the whites with the Methodists somewhat less numerous. There are some half a dozen exclusively Guinea churches in the two counties of which the ones at Chestnut Ridge and West Hill are examples. The Guineas have their own cemetery at Mountain View. Other cemeteries mentioned in connection with their burials are Shiloh, Chestnut Ridge, Silent Grove, Prichard, and Welch.

Politically the Guineas have shown a strong trend toward the Republican Party in an area where the general voting list shows a tendency for Democratic voters to outnumber the Republican. It is claimed that in Barbour County the Guineas hold the balance of power between the two parties. White politicians, it is said, exert every effort to swing the Guinea vote in their favor. One such propounded a theory with which he hoped to win votes from this group several years ago. He asserted that just after the Revolutionary War a scientist bent on breeding a race of supermen brought the ancestors of the Guineas into the Narrows on the Tygart River to raise them in isolation from the rest of the world. We are not told whether this attempt at flattery gained the votes he desired. Another political figure asserted on the witness stand that he would be proud to have his daughter marry a member of the Guinea race. Neither of these statements accorded with local white public opinion.

The contempt of some of the neighboring white people for the Guineas is marked. They are regarded as the dregs of society, as outcasts of little consequence or importance. Others among the whites feel much more sympathetic toward the Guineas and speak of them as capable people when they are given opportunities for advancement. The chief complaints which one hears made are chicken-thieving, bootlegging of illicit liquor, and similar derelictions. Occasionally there are serious altercations within the group, ending in homicide or other serious assaults. As before noted, cases of arson have also been charged to the Guineas.

The mixed bloods, along with other country folk, congregate in the town on Saturday afternoon and evening to gossip and meet their friends. In Philippi the courthouse is a favorite rendezvous for Guineas, and some may be found there at almost any time. In Grafton they congregate in front of the A. and P. Store. Fiddle-playing and singing were favorite recreations with the older generation. They are said to be particularly addicted to the old, well-known Negro spirituals. There is an annual fair held in September by the Guineas near Philippi, and this is entirely organized and conducted by them.

In the military draft for World War II the Guineas of Taylor County have gone for the most part into the army as whites. Apparently there was some sort of prior agreement among them to register as white rather than as colored. In Barbour County, on the other hand, draftees are said to have gone under both categories. The type of racial classification for the draft can be ascertained by watching the lists published in the newspapers whereby the two races (white and colored) are reported separately.

When Guinea youths migrate or go into the army they often return to the ancestral hearth bringing white girls as brides, and the latter are faced with the social problem of meeting their varicolored in-laws. This situation has been said to result occasionally in divorce or annulment due to the difficulties of adjustment. One such case was mentioned in which a dramatic racial denouement occurred when a wealthy bride drove up to the poor dwelling of her husband's people in her "fancy" car and was shocked beyond words to discover that they were locally considered as colored.

In recent years there has been apparently an increasing resistance on the part of the Guineas to their classification as "colored." One doctor in a town hospital had trouble with a Guinea mother who threatened a lawsuit because he had listed the child born to her as "colored."

Permanent migration out of Barbour and Taylor Counties has been recommended by local white officials as the best solution for the individual Guinea. By moving to a community in which there is no knowledge of the Guineas as a group it is quite possible for the individual to pass into the white classification in many instances.

Two incidents of this type might be cited. In a nearby county seat there was a Guinea man of unusual physique, tall and sturdy, who worked with a paper and pulp company. As time went on, by reason of his skill and industry, he was promoted to the position of foreman and finally to plant superintendent. Possessed of a good income and reputation, he stood high in the estimation of his neighbors in spite of the known fact that he was of mixed-blood descent. His attractive daughter was sent to a girls' finishing school in Virginia and passed without question as white. A man instructor was attracted to her and the two were married. Soon afterward the new bridegroom met his father-in-law and the latter took him aside and told him the whole story of the Guinea racial background with the suggestion that the marriage might be annulled if he so desired. The bridegroom did not flinch, however, and accepted the situation, taking a position with the paper mill, and never returned to his former teaching post. He and his wife never had any offspring, however, so the story goes.

In another instance a Guinea youth played on a high-school football team in a town nearby and made a splendid record. Subsequently he went to a Virginia college for four years, graduated, and married into a white family of good status with apparently no trouble ever arising over his race.

In the local courts of Barbour and Taylor Counties a series of lawsuits over school attendance took extensive testimony from neighbors, local reputation, birth records, marriage records, voting records, and school and church attendance records, regarding the race of the Guineas. In the census records persons with Guinea family names in Barbour and Taylor Counties are classified as "mulatto" in the period from 1810 to 1880.

If there is such a thing as group character one of the traits assignable to the Guineas is an interest in skill and cleverness. It takes the form of a real dexterity and an emphasis on the clever and the genuine use of skill. At West Hill the Guineas are said to have a special "telegraphic" system of their own for transmitting news almost instantaneously, for everybody there seems to be immediately aware of any stranger approaching the top of the hill. Quite a number, moreover, have gone to college and later served as teachers or professional men among their own kind or elsewhere. There is apparently a very marked emphasis on education and higher learning.

An instance of cleverness may be cited from a case occurring about 40 years ago.

A certain mixed-blood man, A. N., owned an old gristmill in the Cove District of Barbour County. For several years his son R. A. was with a circus but later came back to work in the mill and put the tricks he had learned into practice to mystify his neighbors. It soon came to be noised about that the old mill was haunted. Boxes and barrels would move mysteriously across the floor and other strange things happened. The local populace for miles around came to see the curious antics of the ghost. A certain "Capt." J. R. undertook to "lay" the ghost. He went to the mill one evening and after considerable wrangling R. A. consented to be tied up; this, "Capt." said, would show whether R. A. was the ghost. Barrels began to roll over the floor and down the stairs, while R. A. struggled with his bonds and shouted loudly about losing his grain. A rock or small piece of quartz dropped mysteriously upon a scale, and "Capt." wrapped it up in his handkerchief and took it home for examination in the daylight. Upon arriving home he locked the handkerchief and quartz in the drawer. When morning came he unlocked the drawer, took out the handkerchief and untied it, but the quartz had disappeared. That put an end to "Capt.'s" attempt to lay the ghost.

According to one informant the Guineas can be divided into three sets, locally illustrative of variation in character. These are (1) the West Hill group of Taylor County, (2) the Chestnut Ridge group of Barbour County, and (3) the Clemtown group on the borders of Barbour and Taylor Counties.

The first group were characterized by fairly good behavior, industriousness, and the fact that they got along very well with their neighbors. They were still regarded as in a separate status from the whites, however, and a few years ago when one of these persons, a prosperous farmer, attempted to buy a farm in another part of Taylor County where Guineas were not previously settled the white neighbors got together and effectively barred the sale.

The second group lived in an isolated section somewhat apart from all neighbors and were extremely backward because of the poor quality of their land. They were said also to be more "mixed up" racially than the other two groups. Their position was definitely not good.

The third group had good farmland and for a long time were very progressive and frequently prosperous rural folk. They kept up their taxes and were careful of their racial affiliations, mixing only with the equally respected West Hill "crowd." But during Prohibition they went in rather heavily for bootlegging, and this has sadly deteriorated their previous good reputation in the region.

The Guineas as a whole are strongly characterized by the spirit of cooperation in spite of the factions and internal disputes. Whenever the advantage of the group as a whole is at stake they are quick to notice it and to bring to bear a common effort. This is shown in the attitude regarding school classification as "colored" and in the agreement to register uniformly in one county as white for the draft. As previously noticed, the phrase "our people," is employed for themselves and betrays a certain degree of consciousness of kind. A certain aggressiveness is also exemplified in the interest in court or legal procedures, especially those involving their own status.

The history of a racial minority of this type must be gleaned from local records of births, deaths, and marriages and from the census records of persons with the Guinea family names in the "free colored" or the "mulatto" categories. One thing that can be established from the outset is that for a long time the Guineas have been intermarrying among themselves and that matings with outsiders have been definitely in a minority. For instance, an examination of 31 marriages of Collinses from 1856 to 1915 discloses that only three were with persons of non-Guinea family name (Douglas, Stalnaker, and Davis), about 10 percent. Similarly, in a list of 81 Croston marriages from 1858 to 1931 only 8 were with persons of non-Guinea family names (Kisner, Hunter, Hendrick, Parsons, DeCost, Ross, Wilson, and Moore), again about 10 percent.

In explaining the origin of the Guineas

some attention must be given to the existence of still smaller knots of people settled here and there in the region farther east. For instance, there is the small colony of half a dozen families of mixed Indian descent at present located on the Blue Ridge Mountains near Boonesboro (Washington County), Md. These may be descended from two family groups named Perl and Patterson, which were located in the vicinity of Jefferson, Lander, and Catoctin Mills in 1889. In that year James Mooney, the Smithsonian anthropologist, sent out questionnaire forms to a number of communities in Maryland, Delaware, and North Carolina on various topics having to do with Indians and Indian remains still in the vicinity. The results are still in the archives of the Bureau of American Ethnology at Washington. Among them is the notice of the above-mentioned small group.

He gives similar notice about the existence of three or four families going by the name of Mail or Male, living in the extreme western part of Maryland near Oakland and Deer Park who had traditionally migrated from Hampshire County, Va., a few generations before. It is likely that from these much smaller pockets of Indian remnants the recruits were drawn together sometime during the nineteenth century to form the nucleus of the larger present-day settlement of Guineas in Barbour and Taylor Counties, W. Va. (Gilbert, 1946).

In Table 2 is shown the development of Guinea family names in selected counties of Virginia, later West Virginia, and the increase of their number with each decade is evidently an index of some process of multiplication within an isolated area and with consistent inbreeding. The history of the race, then, is written largely in the increase in the family names in limited areas of the State (Woodson, 1925, pp. 175, 187, 188).

The name "Male" occurs in a few scattered instances in Chesterfield, Norfolk, and Hampshire Counties of Virginia, in York and Bedford Counties of Pennsylvania, and in New York City in the census lists of 1784 and 1790 for these areas. None of these are in connection with persons designated as nonwhite.

TABLE 2.—OCCURRENCE OF GUINEA FAMILY NAMES IN COUNTIES OF VIRGINIA (LATER WEST VIRGINIA) 1810–1880
(Numbers of families, free colored or mulatto, with these names in each decennial census)

Name	Harrison County (1810–1840)	Randolph County (1810–1840)	Barbour County (1850–1880)	Taylor County (1850–1880)
Adams			–, –, 1, 1	–, 2, 1, 2
Collins	–, –, –, 1	–, 1, 1, –	1, 3, 6, 4	–, –, 1, –
Croston		–, –, –, 1	2, 6, 10, 8	–, –, 1, 1
Dalton			5, 1, 4, 4	–, –, 1, –
Dorton		–, –, –, 1	–, –, 2, 1	–, –, –, 1
Kennedy (Canada)	1, 2, 2, 1	–, –, –, 2	2, –, –, 4	
Male	–, 1, 1, 5	–, 4, 4, 10	11, 11, 23, 35	2, 4, 6, 5
Minard (Miner)			–, –, –, 2	–, –, –, 1
Newman	–, 3, 3, 2	–, –, 2, 2	6, 3, 5, 5	2, –, –, –
Norris		–, 3, 3, 5	5, 1, 2, 4	–, –, 1, –
Prichard			–, 1, –, 2	1, –, 1, –

In the Virginia census of 1782–1784 there were a number of Collinses, Norrises, Pritchards, and Newmans, whose racial character, outside of the fact that they were not slaves, is unmentioned. The county records seem to indicate that the Newmans stem from Loudon County, Va., while the Crostons and the Males both appear originally in Hampshire County of that state. According to one account the Pritchards are of slave origin from Hampshire County, Va. The Minards have a tradition of their Pennsylvania origin. While the Newmans claim an Irish background, and the Males an English, the Minards and Crostons assert a Dutch origin for their family names. Both Norrises and Males have ancestors of Indian or half-Indian race in their family genealogies. One or two cases of Portuguese intermarriage with Males are recorded. It is interesting to note that one theory of Guinea origins traces them back to Spaniards, perhaps some lost followers of De Soto. The name Adams is a rare one among the Guineas but is shared by them with mixed Indian groups in Virginia and with the Wesorts in Maryland, another mixed group. The name Collins, it is also worth while to note, is one of the commonest surnames among the Melungeons of Ten-

nessee, a mixed group similar to the Guineas. In addition to Adams, the surname Newman is shared by the Guineas with the Wesorts of Maryland. The name Norris or Morris is shared with the Nanticoke mixed bloods of Delaware.

The derivation, then, of the Guineas is an extremely complex picture. We can reconstruct their history tentatively on the basis of partly runaway slaves, partly freedmen, partly mulattoes, some stray Indian families, and perhaps partly recruits from neighboring mixed peoples of the same kind such as the Virginia tidewater groups, the Wesorts and the Melungeons. How this group first came together, why certain family lines only were selected for the inmarrying group, and where the dividing line exists between true mulatto and Guinea, are unclear parts of the picture. The tendency to marry only within certain family lines reminds one of the preferential mating rules of some of the primitive Indian societies of North America.

Another puzzling problem is the origin of the stigmatization attaching to the Guineas. There are many families of West Virginia, as in other parts of the United States, who are proud to claim Indian blood in their veins and who are not stigmatized for it. In the case of the Guineas the inference is that they are *all* in some degree part Negro in blood, but this again is difficult to prove and also difficult to believe. There may be a lingering idea that these mixed bloods are mainly of runaway slave origin.

In considering the future prospects of the Guineas it can not be too strongly emphasized that the more thoroughly they are studied and their origin understood the better will be their chances of ultimate absorption and acceptance as members of the larger ethnic group of undifferentiated citizens in the United States. Already they have achieved progress in this direction as compared with some of their similar mixed relatives in neighboring States. It might be worth while to itemize a few of their characteristics in comparison with the Wesorts, a similar racially mixed group some 200 miles eastward near the mouth of the Potomac (Gilbert, 1945).

The environmental circumstances of the two groups are somewhat contrasting, the Wesorts being located on the Coastal Plain and in the neighborhood of tidal or near-tidal swamps, while the Guineas are located in the Allegheny Plateau area on the ridges and narrow river valleys protected by laurel thickets. The economic development of the Wesorts has been mainly along agricultural lines, while that of the Guineas has been in both agriculture and the extractive industry of mining. The Wesorts have been forced by a variety of factors into Negro institutions or into institutions whose membership is largely Negro (schools and churches), while the Guineas have segregated out in their own schools and churches. One of the important factors in Wesort development has been the large amount of trade relationships these people have had with Negroes, especially in urban or suburban environment. The Wesorts have many, if not most of their business dealings with Negroes, such as selling farm produce and buying up material for salvage. The Guineas do not seem to have gone much into trade, and where they have the business dealings have been more with whites. The Guinea churches, being organized on an independent congregational basis, have been easier to segregate by themselves than in the case of the Wesorts, who are Roman Catholics and attend parish churches in which either Negroes or whites preponderate.

The location of the Wesorts is in an area where Negroes make up practically half of the population, while that of the Guineas is in an area where Negroes are scarcely as numerous as the Guineas themselves. The result is a situation of "southern" social surroundings for the former and "northern" social surroundings for the latter. The overflow of Wesort population has been into cities such as Washington and Baltimore with strongly fixed racial traditions of segregation, while that of the Guineas has been to cities of Ohio and Michigan where conditions are fluid and possibilities of "passing" are more frequent.

In the rural environment there has been

much more of the dependency relationship in the case of the Wesorts than in the case of the Guineas. The former have been mainly tenant farmers, scattered about over a wide area, while the latter have been primarily small landholders concentrated in large masses within small neighborhoods. The economic life of the Guineas is considerably more variegated than that of the Wesorts and their possibilities of making a living at present seem much better. On the other hand, there is no tradition of craftsmanship or fine artisan work among the Guineas as there has been in past times among the Wesorts.

The sum and substance of this comparison seems to indicate an increasing identification, in the case of the Wesorts, with the Negro minority while on the contrary the ties of the Guineas have become increasingly stronger with the whites. In a biracial society such as the United States has long possessed the in-betweens tend in the long run to go over as a body into either the one or the other of the two larger groups. In the present comparison the Guineas seem in a better way to solve their minority racial status problem than do the Wesorts through absorption in the larger racial group.

In the case of the Guineas independent organization for group ends would seem to be largely superfluous, if not positively harmful, in the sense of emphasizing minority status. In the case of Wesorts it would seem that group organization would be of the greatest value in preserving an identity of group status which is fast being lost under present tendencies.

It is to be hoped that the present school controversies involving the Guineas will soon be solved. Recognition that Guinea schools are not "Negro" would be of the greatest assistance in this direction. A policy of encouraging greater dispersal for these mixed bloods would also be helpful. A modification of segregation to the extent of granting greater leeway for social participation in white churches and schools by Guineas is to be anticipated. In the long run complete absorption of these mixed bloods into the white community is very likely to take place.

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CHEMISTRY.—*Salt ribbons and ice ribbons.*[1] ROLAND W. BROWN, U. S. Geological Survey.

Recently I soaked a sample of clayey peat in water overnight in a glazed earthen bowl borrowed from W. H. Hass, one of my colleagues. The glaze on the bowl was extensively cross-fissured, the fractures being barely visible to the naked eye. In the morning I found the outer surface of the bowl covered with isolated small ribbons as well as polygonal patterns of a white salt growing at right angles to the surface out of the minute cracks in the glaze (Figs. 1–4). The ribbons were thin, curly, striated, and fragile, from 1 to 5 mm. long, and were only lightly attached to the bowl. When I showed this effect to Dr. Hass and his assistant, Patricia Proctor, they were not surprised, for they had frequently found larger and more varied salt ribbons on the bowls in which they liberate conodonts by digesting limestones and shales in acetic acid. Qualitative tests by W. G. Schlecht, another of my colleagues, showed that the salt was principally calcium acetate. As the peat contained no lime I concluded that the salt ribbons developed from a reservoir of the salt, residual in the pores of the bowl from previous use.

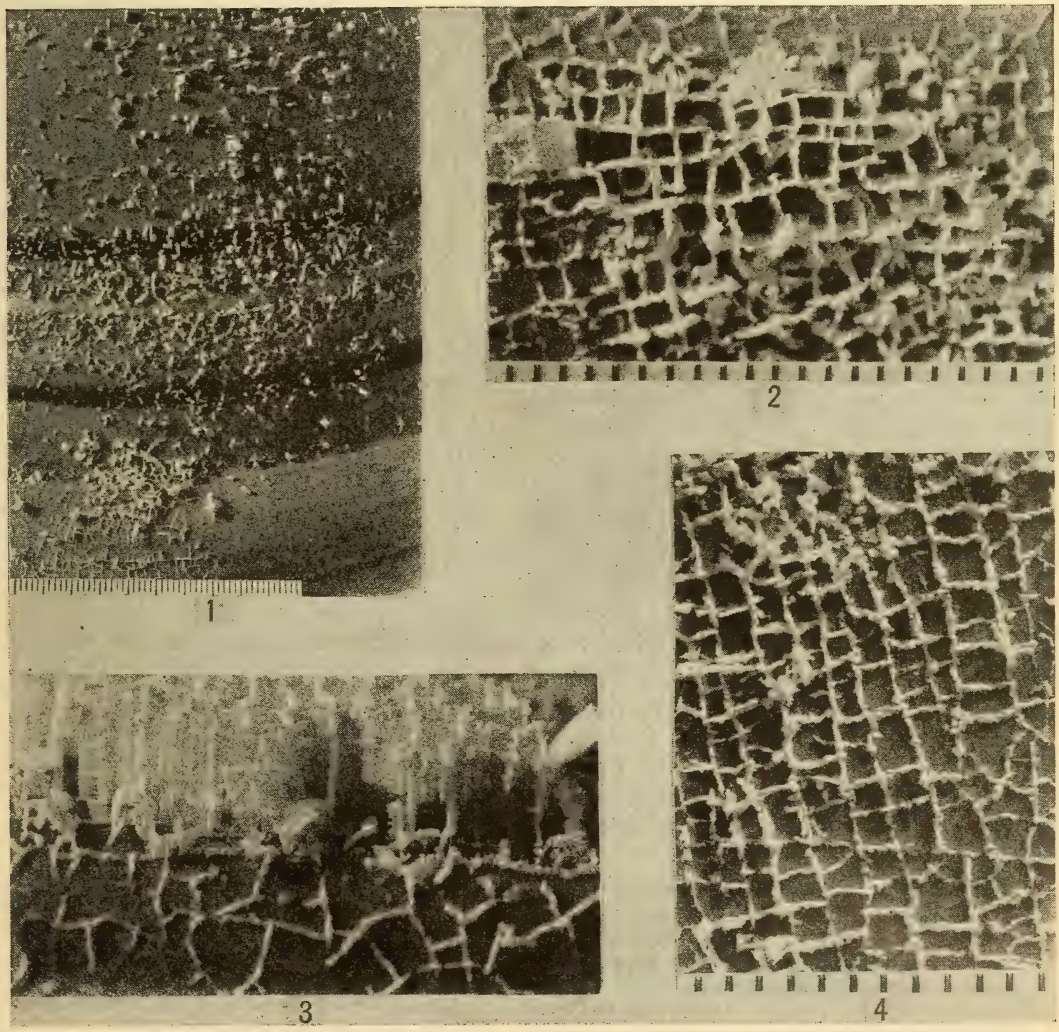
The ribbons were probably formed as follows: Calcium acetate was already present in the pores of the bowl, having seeped in from solutions previously in the bowl. Fresh water in the bowl permeated the pores, dissolving the calcium acetate and pushing the solution forward toward the surface. The warm temperature and moderate humidity in the room promoted evaporation from the surface of the bowl, thus stimulating the capillary flow of salt solution through the bowl. The salt was deposited just within the pores and interstices of the glazing, and the flowers or ribbons were pushed bodily outward as more solution seeped forward and the water evaporated. If deposition did not take place just beneath the surface the ribbons could not remain attached to the bowl. The curvature of the ribbons is caused by more rapid growth on one side than on the other. By touching the tips of several ribbons with drops of red ink I was able to see plainly that the ribbons grew from the base and not from the free end. They were, therefore, solid structures, without internal canals.

The deposition of salt at small apertures produces several kinds of structures simulating the natural helictites (not stalactites or stalagmites) that sometimes develop on cave walls and ceilings. R. E. Janssen (1944), for example, observed two kinds of salt growths, which he called "pickle helictites," that formed at small holes in the lids of pickle jars—a solid but delicate kind, and a hollow, sturdier kind. As the helictites had already completed their growth before he discovered them, Janssen had no opportunity to determine whether the solid forms grew from their bases or at the tips by capillarity of materials through their interiors. The hollow forms evidently developed somewhat in the manner of geyser cones. The growth of helictites has, however, been studied in a series of ingenious laboratory experiments by L. C. Huff (1940). He demonstrated that some helictites, at least, are tubular and grow at the free end from solutions traveling along narrow interior channels. By placing a porous plate over the mouth of a bottle containing sodium thiosulphate and inverting, Huff obtained artificial salt "flowers" comparable to natural "gypsum flowers." These "flowers" were, therefore, formed essentially in the same manner as the salt ribbons on my bowl.

Although salt ribbons of several kinds have thus been observed before, I do not know of any paper that notes the similarity of the phenomenon to the formation of ice ribbons. The latter are thin, white, curly structures that grow to a length of 10 or more centimeters from the dead stems of some plants just above the ground in the early frosty period of winter before the ground is thoroughly frozen. Sir John

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior. Received November 16, 1945.

Herschel (1833) was probably the first to report this phenomenon, having observed ice ribbons on thistles and heliotropes. John LeConte (1877) found them on the stems of a species of composite, *Pluchea* [*Conyza*]. More recently W. J. Humphreys (1925) has reported fine examples seen on the stems of the mint, *Cunila origanoides*, sometimes called dittany and stonemint. Perhaps the most spectacular specimens, however, are those described by W. N. Clute (1927; 1932) from a composite called white crownbeard, *Verbesina virginica*, which seems to be the preeminent ice plant. Although these and other papers have speculated on the process by which ice ribbons are formed, some details remain unexplained. In general, however, there is agreement that the ground must remain warm enough to prevent soil moisture from freezing, thus permitting it to flow upward in the stems of plants; and that the temperature, pressure, and humidity of the air must be such that water permeating



FIGS. 1–4.—Salt ribbons on the outer glazed surface of a bowl (millimeter scale indicates magnification): 1, Surface of the bowl showing isolated ribbons and a polygonal pattern in the lower left corner; 2, 4, enlarged views of polygonal patterns from other portions of the bowl; 3, side view of ribbons in a polygonal pattern. The patterns are governed by the cracks in the glazing. Photographs by Lloyd G. Henbest.

a plant stem will freeze as fast as it appears at or just beneath the surface of the stem. Roots are apparently little, if any, involved in this process, for stems that are carefully cut and replaced in the ground will produce ribbons. Passage of the water up through and across the stem is probably by way of the vascular tissues, but whether the death of the stem has enlarged or altered these passages so as to permit a freer flow of water is unknown. Ribbons may be produced on successive nights from the same stem, raising as much as 60 cc of water each night. The flow of water radially across the stem apparently takes place along the medullary rays, and the ice ribbons begin as thin crystals at the ends of these rays beneath the surface of the stem. The species of plants that habitually produce ice ribbons should be examined to see whether their medullary rays resemble one another closely.

Salt ribbons and ice ribbons thus seem to have much in common mechanically in their development. The ice crystals or pillars surmounted by particles of earth or rock, seen frequently in open ground during mild, alternately thawing and freezing winter weather, are coarser structures, but evidently develop in somewhat the same manner as ice ribbons from the stems of plants, namely, by the freezing of water as fast as it rises from pores in the ground. In quite a different category from ice ribbons belong ice stalactites, stalagmites, and foam "volcanoes," described by H. J. Schaefer (1944). The latter resemble geyser cones in outline and appearance, but are fragile structures formed by the freezing, under proper atmospheric conditions, of foam pushed up slowly but continuously through holes in ice below waterfalls.

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ENTOMOLOGY.—*Synoptic revision of the United States scarab beetles of the subfamily Dynastinae, No. 2: Tribe Oryctini (part).*[1] Lawrence W. Saylor, Research Associate, California Academy of Sciences.

This paper continues the series on United States dynastine scarab beetles and includes the three genera differentiated in the following key:

1. Apical margin of posterior tibia evenly truncate, never with angulations or teeth (lateral view); real apex of clypeus *beyond* (i.e., apical of) the apparent carinate apex; front male tibia frequently edentate. *Cheiroplatys* Hope

   Apical margin of posterior tibia never evenly truncate, always with several angulations, or teeth; apical carina of clypeus, *if* present, right *at* the apical margin.....2

2. Mandibles always large, always well exposed, always armed externally with teeth or else square in outline (*cessus*); apical margin of posterior tibia usually with 1 or 2 sharp angulations or 1 to 3 or 4 teeth. *Strategus* Hope

   Mandibles usually hidden beneath clypeus, or only edges exposed, and always unarmed externally; usually with 5 to 9 small to large teeth on outer apical margin of posterior tibia.....*Xyloryctes* Hope

Genus **Cheiroplatys** Hope

Cheiroplatys Hope, 1837, p. 84; Lacordaire, 1856, p. 411; Arrow, 1937b, p. 37.

Orizabus Fairmaire, 1878, p. 260; Bates, 1888, p. 320; Casey, 1915, p. 222.

[1] Received September 27, 1945.

Pseudaphonus Casey, 1915, p. 210; Arrow, 1937b, p. 35.
Aztecalius Casey, 1915, p. 228.

Arrow lists 32 species in this genus in his 1937 Catalogue; many of these are synonyms and are here listed as such, and additional ones from our faunas will probably prove to be synonymous. This genus is one of those that occur apparently only in the American and Australian regions, and the majority of the species are from New Guinea and Australian localities. There is a great deal of variation in the thoracic armature (presence or absence of a tubercle and strong fovea) as well as in the height and width of the one or two head carinae, which may be much worn in numerous individuals, thus giving them a superficially different appearance; such is also true of the front tibia, which normally in the male of some species, and infrequently also in the female, may be nontoothed externally, but broadly rounded or uni- to bisinuate.

KEY TO UNITED STATES CHEIROPLATYS

1. Size very large (21–24 mm); pygidial punctuation variable, from nearly smooth to densely subrugosely punctate, but most commonly the center disc finely and not densely punctate; male front tibia usually rounded externally and not toothed; clypeal apex with short carina, which is usually interrupted at middle and obtusely bidentate, rarely nearly entire; clypeal base with a small to large tubercle, this rarely semicarinate but then the hardly obvious carina obsolete at sides; center-apex of thorax deeply foveate and tuberculate, or entirely plane (*i.e.*, either evenly convex or flat)..... *clunalis* (LeConte)
   Size much smaller (14–18 mm); clypeal carinae variable, not as above; thorax only rarely foveate or tuberculate.....2
2. Clypeus strongly narrowed in front, apical carina much shorter than half the length of clypeus at base, and strongly elevated and usually narrowly interrupted at middle, thus appearing bidentate; front with a large tubercle, this sometimes a little finely carinate to each side, but never with a strong raised carina; pygidium always very densely and finely cribrately punctate over entire disc, rarely a little sparser at center.
   pyriformis (LeConte)
   Clypeus very broad in front, apical carina much more than half the length of the posterior carina and always raised, entire and straight; thorax in males usually foveate at midapex and tuberculate or not, usually plane in females; pygidial sculpture cribrate and close at sides, most specimens with small to large midcenter discal area smooth, or with finely sparsely punctate area.
   isodonoides (Fairmaire)

Cheiroplatys clunalis (LeConte)

Aphonus (?) *clunalis* LeConte, 1856, p. 23; Bates, 1888, p. 321.
Cheiroplatys verticalis Fall, 1905, p. 272. (New synonymy.)
Orizabus clunalis (LeConte), Casey, 1915, p. 226.
Orizabus ligyrodes Horn, 1885, p. 125.
O. sallei Fairmaire, 1878, p. 262.
O. marginatus Fairmaire, 1878, p. 262. (New synonymy.)
O. cultripes Fairmaire, 1878, p. 261. (New synonymy.)
O. frontalis Casey, 1915, p. 226. (New synonymy.)
O. ponderosae Casey, 1915, p. 228. (New synonymy.)
O. parvitarsis Casey, 1915, p. 227. (New synonymy.)
O. snowi Horn, 1885, p. 124. (New synonymy.)

It is easy to see why so many names have been proposed for our United States *clunalis* when one considers the great amount of variability here in the width between the clypeal teeth; the pygidial puncturation; and the presence or absence of, as well as the depth of, the front thoracic concavity. In some specimens the "apical" clypeal transverse carina (which forms the two lateral teeth) is much reduced at the middle, leaving the two ends as rather large isolated teeth; in others the carina is much less reduced medially and the teeth are smaller and much closer together. Some females have the thoracic concavity entirely lacking and the midcenter apex reduced to the faintest tubercle, while others are plane; in fact, in one series from New Mexico (58 specimens), 22 totally lacked the thoracic fovea and of these 22 seven also lacked all traces of a tubercle, giving some idea of the variability of these characters. In several dissected females (including Casey's type of *parvitarsis*) the front tibia are edentate as in most males. Two male examples from Arizona have the clypeal apex much narrower than usual and the two apical teeth so close as to be touching basally, and more reflexed than usual; in all other external characters as well as the genitalia, however, they are typical *clunalis*. I have seen very large series from Texas, New Mexico, Arizona, and Mexico (Hidalgo and Pachuco); also recorded from many other Mexican localities under the names of the synonyms.

Bates separated *cultripes* from *clunalis* only on the nonmargined thoracic base; a Mexican series from Temascaltepec, D. F. (Hinton collector), is equally divided between specimens having the thoracic base margined and not margined, with all intermediates, and as Bates suspected at the time of describing *cultripes* it cannot be separated from *clunalis*.

Cheiroplatys pyriformis (LeConte)

Bothynus pyriformis LeConte, 1848, p. 21; Casey, 1915, p. 211 (*Pseudaphonus*); Ritcher, 1944, p. 28 (*Pseudophonus*) (larvae).
Pseudaphonus ovalis Casey, 1915, p. 212.
P. repens Casey, 1915, p. 212.
P. debiliceps Casey, 1915, p. 213.
P. lucidus Casey, 1915, p. 213.
P. puncticollis Casey, 1915, p. 335.

This species is found rather uncommonly in the Southwest; I have seen it from Colorado and New Mexico only. The variable characters are mentioned in the species key. The male genitalia are nearly exactly similar in shape to *isodonoides*, and it is possible that when larger series are studied the two species may prove to be variants of one species.

Cheiroplatys isodonoides (Fairmaire)

Orizabus isodonoides Fairmaire, 1878, p. 263; Bates, 1888, p. 322 (*Cheiroplatys*); Casey, 1915, p. 228 (*Aztecalius*).

I have seen good series from Mexico and one female from Colorado which I cannot separate from Mexican females of this species. The two large and entire clypeal carinae are very distinctive.

Cheiroplatys brevicollis (Prell)

Orizabus brevicollis Prell, 1914, p. 204.

Prell described this species on three male specimens from "California (W. Horn) and Mexico"; the species was compared to the Mexican *fairmairei* Bates and varied in size from 20 to 22 mm, and so on size it could be confused only with *clunalis*, from which the male genitalic figures will readily separate it. I doubt that the species occurs in the United States but believe that the locality "California" refers to Baja California.

Genus **Strategus** Hope

Strategus Hope, 1837, p. 87; Casey, 1915, p. 238; Arrow, 1937b, p. 35; Ritcher, 1944, pp. 34–38 (larvae).
Anastrategus Casey, 1915, p. 231; Arrow, 1937b, p. 35.
Strategodes Casey, 1915, p. 245.
Strategopsis Chapin, 1932, p. 302.
Scatophilus Chapin, 1932, p. 302.

This American genus is catalogued at 32 species at present and is limited to the West Indies and the American continents. Five species occur in the United States. Various genera or subgenera have been proposed, and to one unfamiliar with the many species in the genus these may seem valid; this is especially true of those species in which both sexes have the thorax and head entirely unarmed (*cessus* etc.) as opposed to those where the male is usually strongly armed. Also, *mormon* appears to be quite distinct in the elongated mandibular tooth as well as the frequently unarmed male head and thorax, but all intermediates occur so that these names do not stand up. Also, as Arrow has rightly pointed out (1937b), genera based on characters entirely sexual are of no value, since the purpose of taxonomy is to rightly place all specimens that may come to hand, and if it is impossible to place the females of many species unless associated with the males, then such genera are obviously of no value whatever.

The larvae feed on decaying vegetable matter in soil rich in humus, as well as in rotten wood, and on roots of oak and other trees; detailed life history and larval character references, where known, are listed under the individual species.

KEY TO UNITED STATES STRATEGUS

(Last abdominal sternite of males widely transversely emarginate one-half or one-third before the apical margin, the line of emargination with long erect cilia; females with last ventral plane, ciliate at apex.)

1. Middle mandibular tooth very long and narrow, nearly twice as long as the others and very sharp and suddenly narrowed for the last half of its length; color always rufo-castaneous; male with short horn on fore thoracic margin and two faint, widely separated tubercles at midapex; female thorax tuberculate before midapex; Kansas, Utah, Texas..... *mormon* Burmeister
   Mandibles variable, never suddenly narrowed at middle or very long and narrow.....2
2. Thorax never with any suggestion of horns in either sex, midapex with *two* small nearly contiguous tubercles; mandibles from above nearly square, in some specimens with a *faint* sinuation to apical and lateral edge;

color normally piceocastaneous; Arizona and New Mexico..... *cessus* LeConte

Thorax horned or not, or midapex either plane or with *one* erect tubercle or small horn; mandibles not as above.....3

3. Thorax with small tubercle at midapex; thoracic disc without further horns in either sex; mandibles with middle tooth much broader and larger than others but very obtuse; color normally rufous to rufocastaneous, rarely rufopiceous; female pygidial apex before and each side of apex entirely impunctate and smooth; size 25–28 mm; North Carolina and Florida..... *splendens* Beauvois

Thorax and mandibles not as above or if somewhat similar (female) the size either larger or pygidium before apex and at each side of apex coarsely setiferously punctate.....4

4. Size small (24–32 mm); males with the three thoracic horns normally long and of nearly equal width near base and throughout; in male minors the horns sometimes short but always rather narrow at base, and disc at center base punctured and smooth, never coarsely cribrate; females with thoracic armature as in *julianus* but thorax noticeably flatter and base never coarsely cribrate before the margin, at most with a few or a single line of coarse punctures; East States to Florida and west to Texas. *antaeus* (Drury)

Size large (37–46 mm); males with horn arising from midapical thoracic margin very short to very long, and each side of thoracic disc before middle varying from two large and well-separated gibbosities to two long horns; if horned, these always much wider basally than apical horn; base thorax coarsely cribrate each side of middle base; females with a small preapical tubercle at middle thorax, and without the posterior gibbosities; thorax just before basal margin on each side of middle very coarsely cribrate; Mississippi and West to Texas and Arizona, to Central and South America. *julianus* Burmeister

Strategus julianus Burmeister

Strategus julianus Burmeister, 1847, p. 133; Casey, 1915, p. 242; Nevermann, 1933, p. 181; Ritcher, 1944, p. 35 (larvae).
S. gaillardi Casey, 1915, p. 244.
S. roosevelti Casey, 1915, p. 241.
S. arizonicus Schaeffer, 1915, p. 47; Casey, 1915, p. 252.
S. tarsalis Casey, 1915, p. 243. (New synonymy.)

The adults of this common and very wide-ranging species are commonly attracted to light; ranges from Mississippi west and through Central and South America. Casey's *tarsalis* was separated by him because the apex of the hind tibia of the unique female type lacked the usual center tooth, but in a female from northern Mexico the left tibia is as Casey described, but the right tibia has the usual small tooth, and specimens from other localities approach it; the tooth is readily worn in specimens that dig a lot.

Strategus mormon Burmeister

Strategus mormon Burmeister, 1847, p. 130; Knaus, 1924, p. 142; Knaus, 1916, p. 79 (biology); Casey, 1915, p. 251 (*Strategodes*).

The unusually long and slender middle mandibular tooth is very distinctive; the species is rather uncommon in most collections because of its somewhat restricted distribution, being known from Kansas, Utah, and Texas.

Strategus splendens Beauvois

Strategus splendens Beauvois, 1805, p. 89; Ritcher, 1944, p. 37 (larvae); Casey, 1915, p. 237 (*Anastrategus*).
S. bosci Beauvois, 1805, p. 89.
Anastrategus carolinensis Casey, 1915, p. 237.
A. cognatus Casey, 1915, p. 236.

A rather uncommon species known from North Carolina to Florida. As with *cessus*, the two sexes here are similar in thoracic sculpturing.

Strategus cessus LeConte

Strategus cessus LeConte, 1866, p. 382; Casey, 1915, p. 233 (*Anastrategus*).
Anastrategus durangoensis Casey, 1915, p. 234.
A. inflatus Casey, 1915, p. 234.
A. tantalus Casey, 1915, p. 235.
A. cavicauda Casey, 1915, p. 233.

Recorded and seen only from Arizona, New Mexico, and northern Mexico. The thorax is unarmed in both sexes and the nearly or quite square mandibles (dorsal view) are very characteristic in fresh specimens, before they have worn the mandibular margins through digging. Small females are easily separated from female *Aphonides dunnianus* by having the thorax foveate, the mandibles not rounded externally, and the basal clypeal carina not entire.

Strategus antaeus (Drury)

Scarabaeus antaeus Drury, 1773, p. 74; Arrow, 1937b, p. 37 (*Strategus*); Forbes, 1906, p. 34 (biology); Manee, 1908, p. 286 (biology); Ritcher, 1944, p. 34 (larvae); Casey, 1915, p. 234 (*Strategus*).
Scarabaeus maimon Fabricius, 1775, p. 10.
Strategus syphax Burmeister, 1847, p. 131.

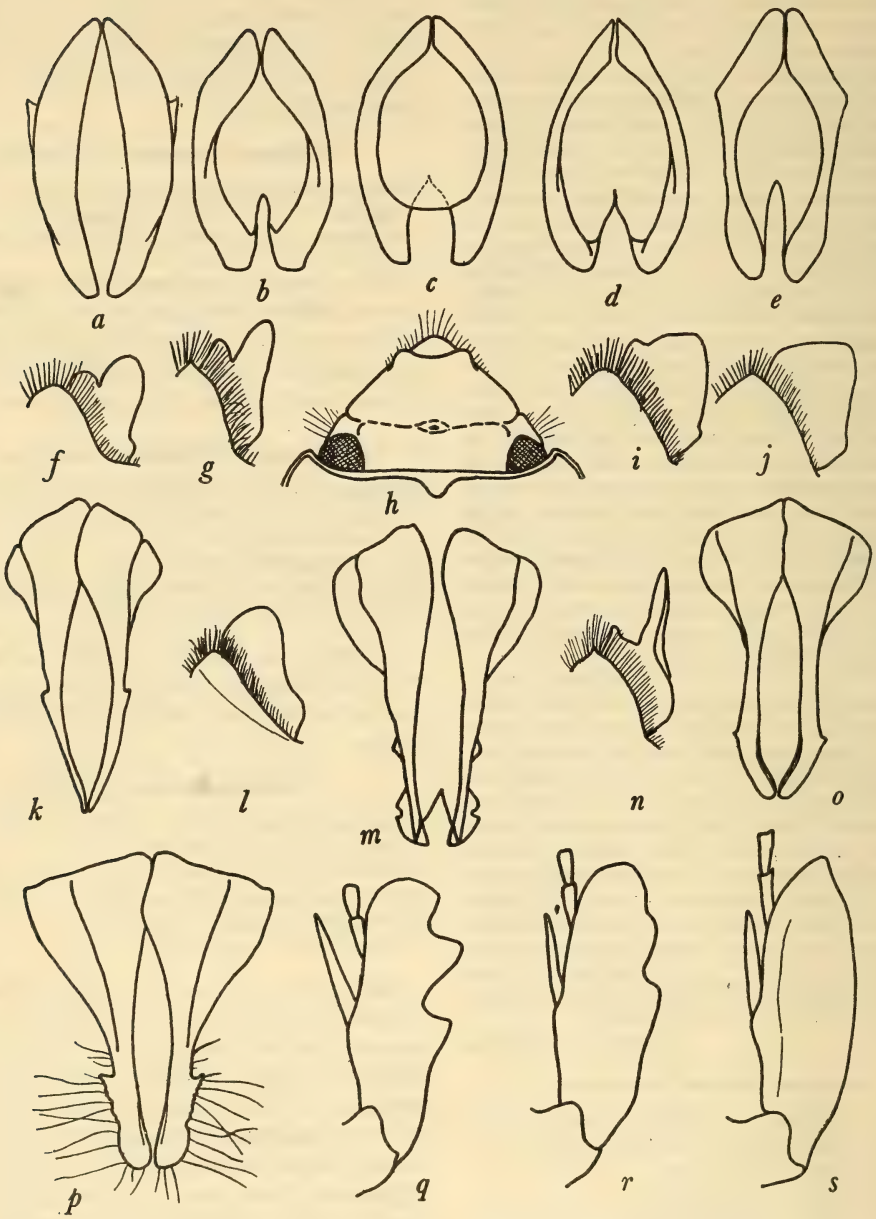


FIG. 1.—(*f–g, i–j, l, n,* dorsal views of mandible; *h,* head of male; *q–s,* front male tibia; remainder are male genitalia.) *a, Strategus julianus; b, S. mormon; c, S. splendens; d, S. antaeus; e, S. cessus; f, S. splendens; g, S. antaeus; h, Cheiroplatys clunalis; i, S. cessus; j, S. cessus; k, C. isodonoides; l, S. julianus; m, C. brevicollis; n, S. mormon; o, C. clunalis; p, Xyloryctes jamaicensis; q, C. pyriformis; r, C. isodonoides; s, C. clunalis.*

S. houstensis Knaus, 1925, p. 182.
Strategodes atrolucens Casey, 1915, p. 247.
Strategodes pinorum Casey, 1915, p. 248.
Strategodes septentrionis Casey, 1915, p. 249.
Strategodes divergens Casey, 1915, p. 246.
Strategodes sinuatus Casey, 1915, p. 250.
Strategodes semistriatus Casey, 1915, p. 250.

This is the commonest, most variable, and widest spread of the United States species, occurring from Rhode Island to Florida, west to Texas.

Genus **Xyloryctes** Hope

Xyloryctes Hope, 1837, p. 90; Bates, 1888, p. 323; Casey, 1915, p. 252; Ritcher, 1944, p. 38 (larvae).

Fifteen species of this genus have been described, two of them West Indian in distribution, eight purely Central America, and the remaining eight names all applying to the common and very variable United States species called *jamaicensis* Drury.

Xyloryctes jamaicensis (Drury)

Scarabaeus jamaicensis Drury, 1773, p. 74; Bates, 1888, p. 323 (*Xyloryctes*); Casey, 1915, p. 254 (*Xyloryctes*).
S. satyrus Fabricius, 1775, p. 12; Bates, 1888, p. 323; Hamilton and Hagen, 1884, p. 107, p. 239 (as *Xyloryctes*) (biology); Weiss, 1921, p. 193 (as *Xyloryctes*) (biology), Ritcher, 1944, p. 38 (as *Xyloryctes*) (larvae).
S. americanus Beauvois, 1805, p. 75.
Xyloryctes faunus Casey, 1895, p. 609; 1915, p. 256. (New synonymy.)
X. hebes Casey, 1915, p. 257. (New synonymy.)
X. lacustris Casey, 1915, p. 255. (New synonymy.)
X. tenuicornutus Casey, 1915, p. 255. (New synonymy.)
X. obsolescens Casey, 1915, p. 256. (New synonymy.)

Ranges throughout the Eastern States and West to Arizona and Texas. The Arizona specimens are very close to the common Mexican *thestalus* Bates in that the male genitalia are identical and the central thoracic lobe is more protuberant than in the Eastern United States specimens, and the species are separable only on the much smoother elytral sculpture of *thestalus*, which must be listed as only a subspecies of the earlier-described *jamaicensis*. Much confusion has existed as to the proper name for this species, and Bates and others refused to accept the earlier name *jamaicensis*, but rules of priority demand its adoption, even though it is unappropriate owing to the species being much more common in the United States than in Jamaica. Most of Casey's types are male minors; nearly all the eastern examples have the male central thoracic lobe obsolete or nearly so, whereas the western ones usually have this lobe obvious to moderate in size. It varies greatly in size, ranging from 21 to 33 mm in length.

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ENTOMOLOGY.—*Nine new species of* Metachroma *(Coleoptera) from the West Indies.*[1]

Doris H. Blake. (Communicated by S. F. Blake.)

The following species of *Metachroma* Dejean were all collected by P. J. Darlington except one, which was taken by J. Acuña in Cuba. Two species are from Cuba and one is from Puerto Rico. The remainder are from the Dominican Republic and are the first ones to be described from that country.

Metachroma laevius, n. sp.
Fig. 1

Nearly 4 mm long, broadly oblong oval, very shiny, head and prothorax reddish, antennae, elytra, legs, and undersurface yellowish brown; occiput of head and prothorax polished, elytra with striate punctures rather indistinct and nearly obsolete over apical half. Anterior and posterior thighs mucronate.

Head with interocular space about half its width, upper half smooth, polished and nearly impunctate, lower half below the transverse groove rather shallowly punctate, a short but not marked median groove. Antennae entirely pale, second joint as long as third, joints 4–6 subequal and not so thick as distal joints. Prothorax about a third wider than long with arcuate sides and a tooth at each corner, disc a little contracted behind the head, smooth, polished and with scarcely discernible, fine, scattered punctation. Elytra with the striate punctures indistinct over the basal callosities and sides and toward the apex; surface very shiny, paler than prothorax. Body beneath shiny, very lightly pubescent. Anterior femora with a large tooth, posterior with a small tooth. Claws toothed. Length 3.7 mm; width 1.9 mm.

Type male, Mus. Comp. Zool. no. 27350; 2 paratypes, one in the U.S. National Museum (no. 57744).

Type locality.—Mount Diego de Ocampo, Dominican Republic, 3,000–4,000 feet altitude, collected in July 1938 by P. J. Darlington.

Other localities.—Puerto Plata, Dominican Republic, collected by Donald Hurst.

Remarks.—This is one of the parallel-sided species of *Metachroma* with the prominently toothed femora, the first of this sort to be recorded from Hispaniola.

[1] Received November 15, 1945.

Metachroma acunai, n. sp.
Fig. 2

Between 3.5 and 4 mm in length, oblong ovate, shining reddish brown, the head with a darker occiput, each elytron with four more or less distinct spots down the middle, the lowest one near the suture; prothorax sparsely but distinctly punctate, elytra with the striate punctures distinct throughout.

Head with interocular space approximately half its width, lower front above labrum and below tubercles coarsely and densely punctate; tubercles well marked by a median line and the groove extending about the inner margin of eyes; occiput finely and not densely punctate and tending to be darker in color. Antennae extending at least to the middle of the elytra, the two basal joints longer and thicker than joints 3–6, joints 7–11 longer and thickened and with the apices dark. Prothorax less than a third wider than long, with arcuate sides, and a small tooth at each angle, disc a little depressed anteriorly and finely and not densely punctate. Elytra with striate punctures distinct to the apex, a little coarser in depression below the humeri; each elytron with four spots, in one specimen, the female, small and indistinct; these spots located (1) in the middle of the base, (2) just below the basal spot a little more toward the humerus, (3) in the middle of the elytron, (4) near the suture at about two-thirds the distance from base to apex. Body beneath shining reddish brown, faintly pubescent, femora without teeth, tibiae of middle and posterior pairs emarginate near apex; claws toothed. Length 3.6–3.8 mm; width 1.3–1.5 mm.

Type male, U.S.N.M. no. 57745; 1 paratype (female) in Museum of Comparative Zoology.

Type locality.—Moa, Oriente Province, Cuba, collected April 13–22, 1945, by J. Acuña.

Remarks.—The distinct punctation of the elytra throughout separates this from other small related West Indian species. In markings it resembles *M. rosae* Bryant from Jamaica, but specimens from Jamaica tentatively identified as the latter species are larger, more robust, and with a nearly smooth prothorax having well-defined markings. This species is named

after Mr. J. Acuña, who has sent in a number of interesting specimens.

Metachroma barahonense, n. sp.

Fig. 3

About 4 mm in length, broadly oblong, shining, yellow-brown, with a deep brown head and prothorax, the latter with a large piceous spot on each side, undersurface deep brown; prothorax densely and finely punctate; elytral striae impressed.

Head with a deep median groove extending nearly to the occiput but with little trace of transverse groove between the eyes, the groove about eyes distinct; interocular space less than half width of head, eyes large; lower front densely punctate; upper part of head smoother, with a few inconspicuous punctures; front pale. Antennae extending below humeri, the five distal joints deeper in color than the more slender basal joints. Prothorax not quite twice as broad as long, with arcuate sides and a seta-bearing tooth at each corner; disc shining and finely and densely punctate except about the edges; a large piceous area on either side. Elytra shining yellow-brown without markings, elytral striation impressed, giving a lightly costate appearance; humeri moderately prominent, a slight basal callosity and a deep intrahumeral sulcus. Body beneath deep reddish brown with the tip of the abdomen paler, lightly pubescent, legs pale, femora not mucronate, claws toothed. Length 4.2–4.5 mm; width 2.3 mm.

Type female and 1 paratype (female), Mus. Comp. Zool. no. 27359; 1 paratype (female), U.S.N.M. no. 57746.

Type locality.—Barahona, Dominican Republic, collected in September 1938 by P. J. Darlington.

Remarks.—This is one of the broadly oblong species and is without markings. The finely and densely punctate prothorax and the more distinctly punctate elytra distinguish it from the other parallel-sided species, *Metachroma laevius.*

Metachroma brevistriatum, n. sp.

Fig. 4

About 2.5 mm in length, oblong oval, shining pale yellow-brown with the tips of the last seven antennal joints darker; the prothorax punctate in the middle, smooth on the sides, the elytra only sparsely striate punctate about the scutellum and a little below the basal callosity, the apical half usually entirely smooth.

Head with interocular space about half its width, polished and with shallow punctation, very little trace of a median vertical groove, the transverse groove between and about eyes well marked. Antennae reaching nearly to the middle of the elytra, first and second joints equal, joints 3–6 slender, 7–11 thicker and more pubescent, 5–11 with darkened tips. Prothorax not twice as wide as long, with arcuate sides and an acute tooth at each corner; disc somewhat contracted anteriorly behind the head, with a double row of punctures in the depression on either side. Punctation not dense or coarse and entirely lacking on the sides. Elytra polished, usually with only traces of striate punctures on the apical half, the only row reaching the apex being the one next to the suture, the others represented by only a few short lines below and about the basal callosities. Elytra slightly widened in the apical half. Body beneath pale, the abdomen occasionally deeper in coloration, shining, nearly glabrous. Middle and posterior tibiae emarginate, claws toothed. Length 2.3–3 mm; width 1.4–1.8 mm.

Type male and 6 paratypes (3 males, 3 females), Mus. Comp. Zool. no. 27352; 1 paratype (male), U.S.N.M. no. 57747.

Type locality.—San José de las Matas, Dominican Republic, 1,000–2,000 feet altitude; collected in June 1938 by P. J. Darlington.

Other localities.—Constanza, 3,000–4,000 feet, Villa Altagracia, Dominican Republic; collected in 1938 by P. J. Darlington.

Remarks.—The small size, pale coloration, and mere vestiges of pronotal and elytral punctation make this species distinctive.

Metachroma obesum, n. sp.

Fig. 5

About 2.5 mm in length, ovate, with yellow-brown elytra and reddish-brown head, prothorax, legs, and undersurface, antennae with the seven distal joints dark at the base; elytra with a spot on the humerus connected to another spot below, two more on the side going down to the margin, and a row of four across

each elytron below the middle; prothorax distinctly punctate, elytra with striate punctation in basal half, apex smooth.

Head coarsely alutaceous throughout, a short deep cleft in middle between the eyes and the usual groove extending across and about the eyes; a dark occipital spot running down to the vertex, interocular space more than half the width of the head. Antennae extending below the humeri, four basal joints pale, remainder dark at the base, second and third joints about equal in length, joints 4–6 subequal, rest much thicker and longer. Prothorax more than a third wider than long with rounded sides and a tooth at anterior and basal angles; surface alutaceous and distinctly but not densely punctate, smooth near the margin; in color deep reddish brown with irregular darker median areas. Scutellum reddish brown. Elytra shining pale yellow-brown with piceous spotting; one on the humerus, three below the humerus, a transverse row from the margin, four other small spots on each elytron forming an interrupted fascia across elytra below the middle. Striate punctation visible nearly to the middle of the elytra next to the suture, but vanishing in apical half and on sides a short way below the humeri. Body beneath shining reddish brown, nearly glabrous, the middle and posterior tibiae emarginate, claws toothed. Length 2.5 mm; width 1.5 mm.

Type female, Mus. Comp. Zool. no. 27353.

Type locality.—Constanza, 3,000–4,000 feet altitude, Dominican Republic; collected in August 1938 by P. J. Darlington.

Remarks.—This is an unusually broadly ovate species and conspicuous because of its elytral spotting and entirely smooth apical half.

Metachroma darlingtoni, n. sp.

Fig. 6

Between 4 and 5 mm in length, broadly oblong oval, shining, pale yellow-brown with a dark streak down the middle of the head, four or two (coalescing) spots across the pronotum, and small irregular spots across the base and below the middle of the elytra; legs banded, and undersurface more or less darkened; elytral striae rather deeply impressed.

Head with interocular space less than half the width of the head, eyes large, a dark streak down the middle of front, and sometimes behind the eyes, jaws also dark; a short median groove and a well-marked one between and about the inner margin of eyes; upper part of head shiny, some traces of obsolete punctation; lower front alutaceous and more distinctly punctate. Antennae extending below the humeri, second joint as long as third, shorter than fourth, the five distal joints a little darker and heavier. Prothorax not quite twice as broad as long with rounded sides and a seta-bearing tooth at each corner; surface smooth, shining, impunctate; lower margin slightly sinuate; pale yellow-brown with two or four spots across the middle. Elytra pale and shining with two or three spots across at base, the largest on the humeri, and a transverse row of small irregular spots below the middle, sometimes another between the basal and apical row in the middle; striation rather deeply impressed, giving a somewhat costate appearance to the elytra; humeri prominent and a distinct basal callosity. Body beneath varying in coloration but in two of the three specimens mostly dark piceous, in the third specimen the abdomen pale. Legs pale, both femora and tibiae with dark spot; rather pubescent; an inconspicuous tooth on anterior and posterior femora; claws toothed. Length 4.2–5.2 mm; width 2–2.6 mm.

Type female, Mus. Comp. Zool. no. 27354; one paratype (female) U.S.N.M. no. 57748.

Type locality.—Constanza to Jarabacoa, Dominican Republic, 2,000–4,000 feet altitude; collected in August 1938 by P. J. Darlington.

Other locality.—Villa Altagracia, Dominican Republic; collected in July 1938 by P. J. Darlington.

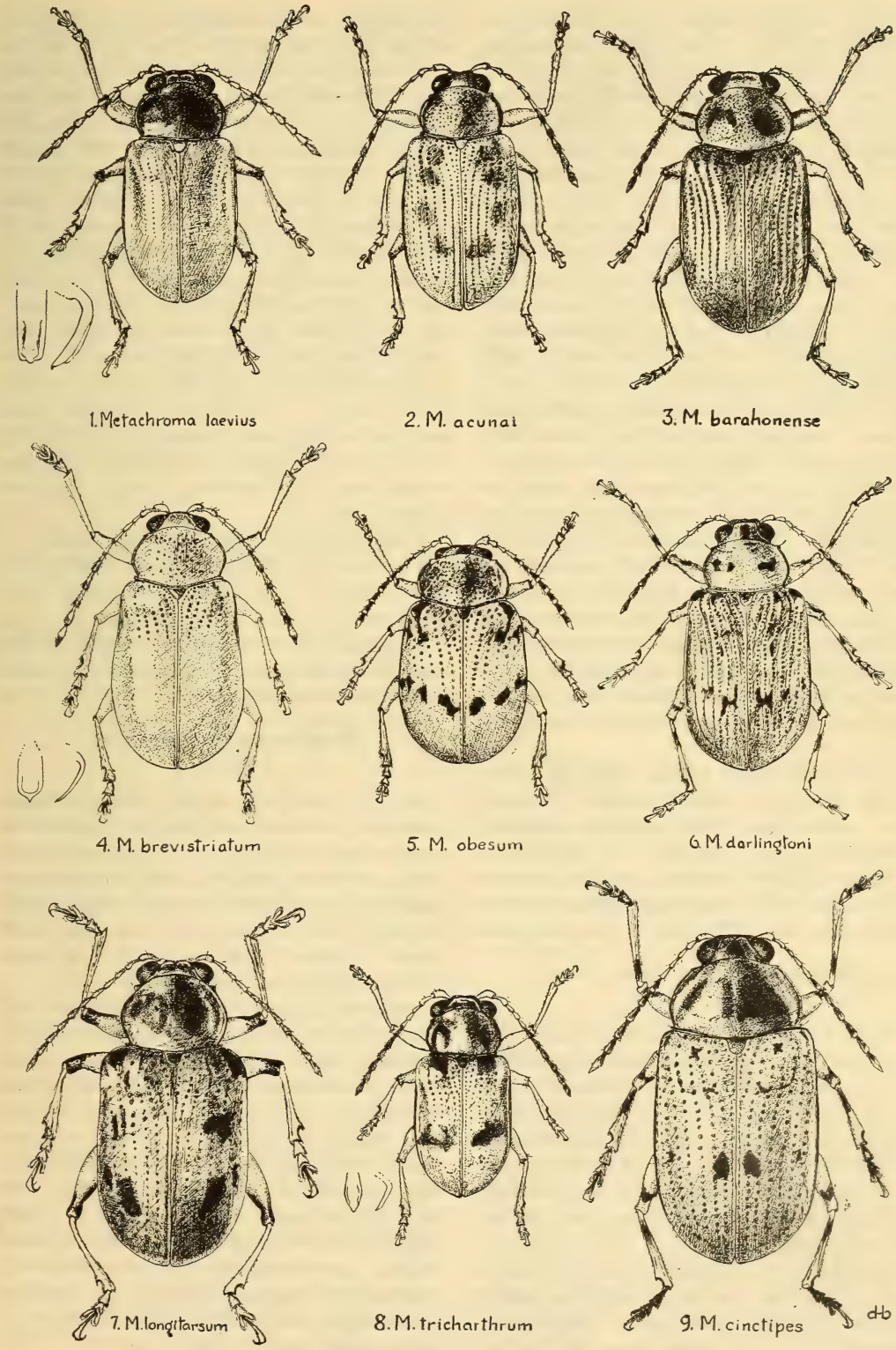
Remarks.—Deeply impressed striae, spotted legs and large eyes are the characteristics of this pretty species.

Metachroma longitarsum, n. sp.

Fig. 7

About 5.5 mm in length, oblong, shining, deep reddish brown with a dark streak down head, two large spots on each side of pronotum, darkened humeri, and two spots down the middle of each elytron; undersurface and apices of femora also dark; elytral striae not impressed, punctures not dense and becoming indistinct toward apex.

Head with large eyes, interocular space less than half width of head, a deep groove between eyes and about inner margin of eyes, and



FIGS. 1–9.—New species of *Metachroma* from the West Indies.

another vertical median one between the frontal tubercles; lower front alutaceous, punctate, upper front smooth with very fine scattered punctures, a dark streak down occiput, jaws also dark. Antennae reddish brown, extending below humeri, second joint longer than third, last five joints somewhat thickened but not much longer. Prothorax about a fourth wider than long, with arcuate sides and a prominent seta-bearing tooth at each corner; disc polished, finely but not densely punctate except about edges; deep reddish brown with large dark areas on either side. Scutellum dark. Elytra parallel sided and rather convex, with well-developed humeral prominences; a deep sulcus within, and a somewhat swollen basal callosity; shining, deep reddish brown with piceous humeri, dark streaks along striae in middle at base and two large spots down the middle of each elytron and another on the side between them. Striate punctures not coarse or very dense, and in apical half, especially on sides, fading away. Body beneath more or less piceous, polished, very lightly pubescent; legs pale except for the darkened apices of femora. Posterior femora with the slightest trace of a tooth, otherwise smooth; claws long, with a tiny basal tooth. Length 5.4 mm; width 2.8 mm.

Type female, Mus. Comp. Zool. no. 27355.

Type locality.—Pico Turquino, Oriente, Cuba, south side, 3,000–5,000 feet altitude; collected in June 1936 by P. J. Darlington.

Remarks.—This species is striking because of its size and dark markings, especially of the femora. The long claws are also conspicuous.

Metachroma tricharthrum, n. sp.

Fig. 8

About 2 mm in length, oblong ovate, very shiny, pale yellowish brown with deeper brown head, prothorax and last six antennal joints, and piceous markings on the occiput, on the sides of the prothorax, and in the middle at the base of the elytra and nearly across them below the middle; sides of prosternum and metasternum also dark; elytral striation only partial, absent in apical half.

Head polished, impunctate, entirely lacking median vertical groove, transverse groove between and about eyes deep; margin about antennal sockets in lower front prominently developed; a darker area on occiput. Antennae extending to the middle of the elytra, second joint nearly as long as first, joints 3–5 slender, 7–11 thickened, last six joints dark. Prothorax nearly as long as wide with arcuate sides, the margin dark, disc polished, and with a dark piceous area on either side; surface finely and not densely punctate. Elytra polished, paler yellow-brown, having a dark piceous area at base between the humerus and scutellum and another transverse area below the middle nearly reaching the suture, margins dark; only the sutural striae entire, the others only partial, disappearing at the sides and middle and over the basal callosities. Body beneath shiny, sides of prosternum and breast dark, abdomen and legs pale. Femora with prominent hairs at apex, tibiae of middle and hind legs emarginate, claws toothed. Length 2.2 mm; width 1.2 mm.

Type male, Mus. Comp. Zool. no. 27356.

Type locality.—Maricao Forest, 2,000–3,000 feet altitude, Puerto Rico; collected May 30–June 2, 1938, by P. J. Darlington.

Remarks.—The conspicuous bristles at the apex of the femora have suggested the name *tricharthrum* for this species.

Metachroma cinctipes, n. sp.

Fig. 9

About 5 mm long, broadly oblong, shining, head and prothorax and most of undersurface more or less reddish brown with piceous areas, elytra and legs paler yellowish brown, elytra with small spots about base and below middle, the legs, both femora and tibiae with dark bands. Prothorax nearly as wide as elytra, polished. Elytral striation distinct.

Head with large eyes, interocular space less than half width of head, a broad piceous stripe extending down the front, lower front deeper brown, jaws piceous, not very shiny, alutaceous with distinct but not dense punctation; median and transverse grooves not very distinct, groove about inner margin of eyes well marked. Antennae extending below humeri, the outer joints thicker and a little darker, second joint longer than third. Prothorax not twice as broad as long, much broader at base than anteriorly, with rounded sides and little trace of a tooth at apical angle, but a well-marked one at base, lower margin sinuate. Surface polished, nearly

impunctate, reddish brown with a large dark area on either side. Elytra not much wider than prothorax with small humeri and short intrahumeral sulcus and very little depression below, the basal callosities not at all prominent; surface shining, striate punctures well spaced and distinct; in color pale yellow brown with remnants of spots about base, a large one on each elytron below the middle near the suture, and a smaller one near lateral margin. Body beneath tending to be reddish brown or piceous, especially on breast; legs with dark bands both on femora and tibiae, and the tarsal joints dark, all femora with a trace of a tooth, most pronounced on the hind femora. Claws with short tooth. Length 4.7–5.6 mm; width 2.8–3.1 mm.

Type female, Mus. Comp. Zool. no. 27357.

Type locality.—Mount Diego de Acampo, Dominican Republic, altitude 3,000–4,000 feet; collected in July 1938 by P. J. Darlington.

Other localities.—Villa Altagracia, Dominican Republic, July 1938, San Jose de las Matas, 1,000–2,000 feet altitude, June 1938, both collected by P. J. Darlington; Puerto Plata, Dominican Republic, collected by Donald Hurst; Mount Basil, northern Haiti, 4,700 feet altitude, September 9, 1934, collected by P. J. Darlington; Furcy, Haiti, collected by W. M. Mann.

Remarks.—This species resembles *Metachroma rosae* Byrant, described from Jamaica, but specimens from Jamaica tentatively identified as *rosae* are smaller, paler, and with much denser punctures on the elytra.

ZOOLOGY.—*A new crawfish of the genus* Procambarus *from Louisiana (Decapoda: Astacidae).*[1] GEORGE HENRY PENN, New Orleans, La. (Communicated by W. L. SCHMITT.)

The new species of crawfish described herein has been collected on several occasions during the past eight years by different carcinologists and though recognized as an undescribed species has been neglected by each because of more pressing duties. Dr. Horton H. Hobbs, Jr., of the University of Florida, and Dr. Rendell Rhoades, of the Ohio Division of Conservation and Natural Resources, have both kindly furnished me with their collections of the species for comparison with the type material in making the descriptions.

I take great pleasure in naming this species in honor of Mr. Percy Viosca, Jr., of New Orleans, who collected the type specimens and to whom I have been indebted for many favors in the past decade.

Procambarus vioscai, n. sp.

Diagnosis.—Rostrum with prominent lateral spines; areola moderately narrow. Thoracic region of carapace less than half as long as cephalic region. First pleopod of first form male terminating in four parts: mesial process[2] a long tapering spine projecting caudolaterally; cephalic process a bladelike process projecting ventrocaudally; central projection heavy, blunt-tipped; caudal process very small, blunt-tipped.

Male holotype (form I).—Body subovate, compressed dorsoventrally. Abdomen about same width as cephalothorax.

Areola wide (length five times width); sides converge dorsally in hourglass type marking, indistinct caudally; areola 26.8 percent of entire length of carapace; six punctations across narrowest part of areola.

Rostrum widest at base, gently tapering, slightly excavate; acumen long (about one-sixth length of cephalic portion of carapace). Lateral spines strong. Postorbital ridges terminating anteriorly in long, sharp, anterolaterally projecting spines.

Surface of carapace bearing fine tubercles and punctations. Two large spines projecting anteriorly on each side of carapace along cervi-

[1] Aided by a grant from the New Orleans Academy of Science in 1940. Received November 1, 1945.

[2] The terminology used here in describing the parts of the first pleopod of the form I male is that proposed by Hobbs (*On the first pleopod of the male Cambari*, Proc. Florida Acad. Sci. 5: 55–61. 1942; and *Notes on the first pleopod of the male Cambarinae*, Quart. Journ. Florida Acad. Sci. 8: 67–79. 1945.)

cal groove. Cephalolateral margins of thoracic region of carapace each with one strong spine near anterior extremity of cervical groove.

Abdomen same width as cephalothorax, slightly tapering posteriorly; approximately equal to cephalothorax in length.

Antennules of usual form.

Antennae nearly equal to total length of crawfish; of normal form.

Antennal scales extending to tip of rostrum, with the usual strong spine on outer margin; triangular in shape, widest point about one-third of distance from base.

First right pereiopod entirely tuberculate;

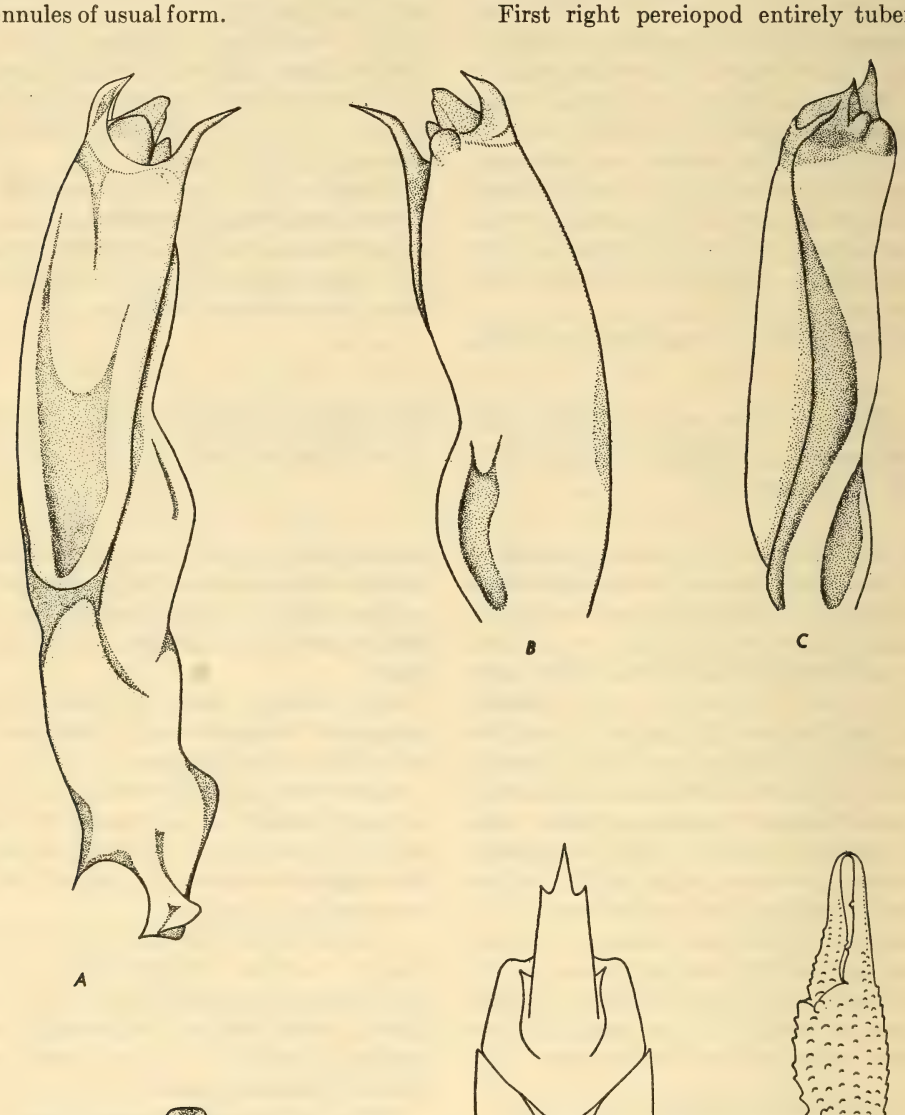


FIG. 1.—*Procambarus vioscai*, n. sp.: First right pleopod of holotype male form I: *A*, mesial view; *B*, lateral view; *C*, caudal view; *D*, annulus ventralis of female allotype; *E*, cephalothorax (holotype); *F*, right chela (holotype).

palm compressed dorsoventrally. Movable finger terminating distally in a sharp, corneous tip bent laterad and extending below the tip of the immovable finger when the fingers are closed; both margins with small tubercles, strongest near base.

Immovable finger with inner marginal ridge bearing small tubercles, and terminating in a sharp corneous tip bent mesially.

Ischiopodites of third and fourth pereiopods bearing hooks. Hooks strong, corneous, bent toward base of the ischiopodite. Hook on third pereiopod stronger.

First pleopod extending to base of third pereiopod; tip ending in four distinct parts as follows: mesial process most prominent, extending laterad in a long, tapering, slightly curved spine. Cephalic process corneous, also prominent, flattened laterally and slightly curved or excavate on its median aspect, appearing as a bladelike process. Central projection corneous, blunt-tipped; line of fusion of centrocephalic and centrocaudal processes clearly marked. Caudal process corneous, very small, blunt-tipped. Rim of apical knob with a ring of setae which hides all except the mesial process from view in fresh specimen.

Female allotype.—The female differs from the male in the following points: carapace more nearly cylindrical in cross section. Annulus ventralis: sinus originating along midventral line in a flattened trough just posterior to anterior margin, turning slightly sinistrad, caudad for about a third of its length, slightly dextrad, caudad for another third of its length, sinistrad, and sharply dextrad, terminating along the caudal margin in a tubercle. On each side the surface is depressed so that the anterior margin forms a ridge, which in turn is shaded anteriorly by the projecting edge of the sternum.

Measurements.—The holotype: carapace, height 18.5 mm, width 17.4 mm, length 41.3 mm; areola, width 2.0 mm, length 11.1 mm; rostrum, length 30.2 mm; abdomen, length 42.0 mm; right chela, length of outer margin 24.0 mm, width at widest point 6.6 mm, length of inner margin of movable finger 16.0 mm, length of inner margin of palm 13.5 mm. The allotype: carapace, height 13.5 mm, width 13.5 mm, length 31.1 mm; areola, width 2.0 mm, length 8.5 mm; rostrum, length 22.6 mm; abdomen, length 32.5 mm; right chela, length of outer margin 15.7 mm, width at widest point 5.2 mm, length of inner margin of movable finger 8.2 mm.

Type specimens.—The male holotype (form I), no. 79925, a male paratype (form I), no. 79926 from the type locality, and the female allotype, no. 79931, from Kingsville, Grant Parish, La., are deposited in the United States National Museum.

Type locality.—Big Creek at Fishville, about 3 miles east of Pollock, Grant Parish, La. They were collected on February 22, 1938, by Percy Viosca, Jr., from the margin of the creek among leaves and other debris accumulated on the lee side of a sandbar. Big Creek is a typical, swift-flowing, sand-bottomed pinewoods Louisiana stream; south of Fishville it joins the Little River. Other crawfishes collected in the same ecological niche with *P. vioscai* were *Procambarus blandingii acutus*, *Orconectes creolanus*, and another species of *Procambarus* as yet undescribed.

Additional specimens examined.—One male form II, 2 females, and 11 juveniles from Rock Creek near Kingsville, Grant Parish, La., U.S.N.M. no. 79927. One male form I, 2 males form II, 4 females, and 2 juveniles from Pollock, Grant Parish, La., deposited in the Alabama State Museum of Natural History at the request of Dr. Rendell Rhoades. One male form II and a female from Calhoun, Ouachita Parish, La. (no. 7-3141-7); 1 male form I and 2 females from Richland Creek near Jackson, Rankin County, Miss. (no. 7-3141-10a); 3 males form I, 2 females, and 6 juveniles from Magee, Simpson County, Miss. (no. 7-3141-12); and 1 male form I, 1 female, and 1 juvenile from Big Swamp near Seminary, Covington County, Miss. (no. 7-3141-13) in the collections of Dr. Horton H. Hobbs, Jr., at the University of Florida.

Relationships.—This species belongs to the section of *Procambarus blandingii*, group of *P. spiculifer*. Its closest relative appears to be *Procambarus versutus*.

Discussion.—Among the series of specimens examined, those from Calhoun, La., and Jackson, Magee, and Seminary, Miss., in Dr. Hobbs's collections appear to be of a smaller race than typical *P. vioscai* and may subsequently be recognized as a subspecies.

ZOOLOGY.—*A new genus and species of minute marine stiliferid mollusks from Florida.*[1]

PAUL BARTSCH, United States National Museum.

Mrs. Athleen V. Underwood has recently sent a small collection of minute marine mollusks to the U. S. National Museum for determination, among which is a remarkable shell that I am unable to place in any of the known genera. I am therefore giving it a scientific status here under the designation of *Athleenia burryi*, new genus and species.

Athleenia, n. gen.

Shell minute, elongate-ovate, thin. Nuclear whorls 3.5, well rounded, smooth, forming a slender apex. Postnuclear whorls strongly tabulatedly shouldered at the summit, marked by lines of growth only. Periphery and base rounded. Aperture ovate; columella short.

Type species: *Athleenia burryi*, n. sp.

The nuclear spire leads me to believe that the genus is a member of the family Stiliferidae.

I take pleasure in naming the genus for Mrs. Underwood, whose fine work in collecting minute mollusks is adding materially to our knowledge of this usually overlooked field.

Athleenia burryi, n. sp.

Shell very minute, elongate-ovate, thin, vitreous, translucent. The nucleus consists of 3.5 whorls, which are well rounded and smooth and form a somewhat styliform apex. The postnuclear whorls are strongly tabulatedly shouldered at the summit. The shoulder extends over about one-sixth of the width of the turns and terminates anteriorly in a sharp angle. The rest of the whorls is slightly rounded. Suture constricted. Periphery rounded. Base long, well rounded. Aperture ovate; peristome slightly thickened at the edge and slightly angulated at the posterior shoulder; inner lip concave and reflected over the short columella; parietal wall covered by a thin callus. The entire surface is marked by feeble inconspicuous lines of growth only.

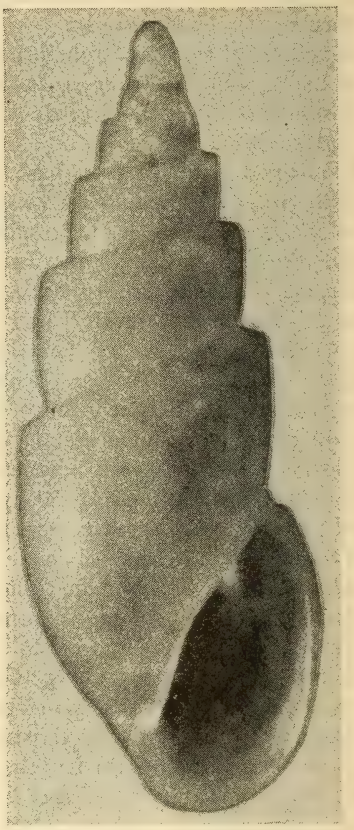


FIG. 1.—*Athleenia burryi*, n. gen. and sp.

The type (U.S.N.M. no. 573616) was dredged in 400 feet off Carysfort Reef Light, Florida. It has 8 whorls and measures: length, 2.1 mm; diameter, 0.8 mm.

I take pleasure in naming the species for Mr. and Mrs. W. A. Burry, whose dredge yielded the specimens.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received October 23, 1945.

Obituaries

Edward Wilber Berry, paleobotanist, emeritus professor of paleontology and former dean at Johns Hopkins University, died early in the morning of September 20, 1945, at Stonington, Conn. Mrs. Berry (nee Mary Willard) died in 1939. Surviving in the immediate family are their sons Charles T. and E. Willard Berry.

Mr. Berry was born at Newark, N. J., on February 10, 1875. After graduation from high school he was for a time connected with a cotton-goods commission house and traveled extensively in the South. From 1897 to 1905, while managing the Passaic, N. J., Daily News, he found a hobby in the study of the Cretaceous deposits of New Jersey and the fossil plants contained therein. Presently his publications on these studies attracted the favorable notice of William B. Clark, head of the department of geology at Johns Hopkins, and in 1905 Clark invited him to become his assistant in paleontology at the university and on the Maryland Geological Survey. By 1917 Mr. Berry had become professor of paleontology, assistant state geologist of Maryland, and senior geologist of the United States Geological Survey, and, besides numerous articles on the Cretaceous floras of the Atlantic Coastal Plain, he had to his credit a large volume on the lower Eocene floras of southeastern North America, which gave him an international reputation as a paleobotanist. This reputation was further enhanced by his travels in South America and his publications on South American fossil plants.

From 1929 to 1942 Mr. Berry was dean of the School of Arts and Sciences at Johns Hopkins and provost of the University. In 1930 he accepted the only degree he ever held—an honorary doctor of science from Lehigh University. Mr. Berry was elected to the National Academy of Sciences in 1922. Besides holding membership in a few foreign scientific societies, he was a fellow of the Geological Society of America, Paleontological Society (of which he was president in 1924), American Philosophical Society, American Association for the Advancement of Science, the Washington Academy of Sciences, and others. He was awarded the Mary Clark Thompson medal of the National Academy of Sciences, but his climactic honor was election to the presidency of the Geological Society of America for 1945.

A bibliography comprising several hundred titles testifies eloquently to Mr. Berry's facile pen and prolific output. Included in this list are two books—*Paleontology* and *Tree ancestors*. As many of these publications represent, literally and figuratively, large amounts of spadework, such as the collection, description, and illustration of specimens, they contain inevitable imperfections which new information should eventually correct. Some of these also bear the earmarks of haste reminiscent of Mr. Berry's newspaper experience. Nevertheless, a survey of the contents of his bibliography reveals a comprehensive, philosophic outlook and unquestionably indicates that he belongs with the immortals of paleobotany.

Although Mr. Berry could be caustic in criticizing the work of others, he was in reality an amiable man and will long be remembered by his former students and professional associates as a hard worker, independent thinker, stimulating teacher, and generous friend.

Roland W. Brown

Harry Vaughn Harlan died at Phoenix, Ariz., on November 6, 1944. He had been a member of the Washington Academy of Sciences since 1919. Dr. Harlan was as widely known throughout the world in his particular field as any American scientist. He was one of those fortunate individuals whose official duties took him into many lands, and the friendships and contacts which he established resulted in a knowledge and appreciation of his work on a world-wide basis that not many men attain.

Dr. Harlan was born at London Mills, Ill., on February 19, 1882. The family moved to Kansas when he was a small boy and he grew up in that State. He was an individual whose ancestry and early training were reflected in his character and philosophy of life to an unusual degree. His ancestry was Quaker, the original American member of the family coming to Pennsylvania with William Penn. While Dr. Harlan himself was not a communicant of any religious group, everything that he thought,

said, and did reflected in a very large measure the religious teachings and philosophies of the Quakers. His hatred of sham and show, his intense love of the truth, his kindliness and thoughtfulness of others, all were a part of this heritage.

Dr. Harlan graduated from Kansas State College in 1904, and he received his M.S. from the same institution in 1909. He received the degree of Sc.D. from the University of Minnesota in 1914.

Soon after graduation from college Dr. Harlan accepted a position in the Philippine Islands, where he remained from 1905 to 1908. During this period he established experiment stations at Iloilo and Boayombong. In 1913 and 1914 he made a trip to the highlands of Peru to study agricultural possibilities in that area. His travel experience included a special survey of food conditions in Central Europe and the Balkans immediately after the close of World War I under the auspices of the U. S. Grain Corporation and American Relief. Incidentally, his estimates as to food supplies proved entirely reliable, although at variance with official reports, and in the end formed the basis of relief activities in that area. Then finally in 1923 he traveled in Europe, North Africa, Abyssinia, and India, searching for materials to be used in the improvement of barley in this country. In the course of this exploration he carried out an extremely successful trip through the then most primitive areas of Ethiopia where Europeans and Americans had been only rarely if at all before. In 1927 he was sent to Europe as a special representative of the Department of Agriculture for conferences on barley grades and grading in connection with exports of both feed and malting barley.

On his return to this country from the Philippines, and after an intervening period of graduate study, Dr. Harlan accepted a position in the Department of Agriculture in 1910. Placed in charge of barley investigations in the Bureau of Plant Industry, he began a long period of productive research on which he was actively engaged to the day of his death. His research on barley covered a broad field of interest as evidenced in his publications. His first work dealt with the morphology of barley in relation to malting. This was followed by studies on the classification of barley and the characters of barley important in breeding and improvement. Then came a series of papers dealing with growth and development of the barley plant and of the barley kernel, and in later years studies on methods and techniques of barley improvement. During all this period he was also carrying forward an active program of barley breeding, and a number of improved varieties widely grown in the United States resulted from his efforts. He brought together one of the world's largest collections of barley varieties. A list of 55 papers, collectively a standard guide and reference on barley, attest to the immense amount and value of his work.

Harry Harlan was characterized by a deep and all-comprehensive love for his fellow man. Being a man of firm convictions, there were, of course, many individuals for whom he cared less than for others; but it can be truthfully said of him that no one ever came to him in trouble whom he did not help. Many individuals, who never knew the source of their assistance, benefited from his helpfulness. This was characteristic. He particularly delighted in helping young people, and he had a long list of young friends, scientific and otherwise, extending from one coast of the United States to the other, and even into foreign countries. The number of young people who were influenced by Harry Harlan is remarkable, the more so since his contacts primarily grew only from his interest and not as a part of any regular duties.

Harry Harlan was a most loyal and helpful friend. Association with him was an inspiration. His broad interests and knowledge were a constant mental stimulus to his associates. The Washington Academy suffered a real loss in the death of this member.

He is survived by his wife, Augusta Griffing Harlan, and two sons, Wilbur Vaughn, of the U. S. Army, and Jack Rodney, of the Woodward Field Station, U. S. Department of Agriculture, Woodward, Okla.

M. A. McCall

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PALEONTOLOGY.—Stiptocrinus, *a new camerate crinoid genus from the Silurian.*[1]

EDWIN KIRK, U. S. Geological Survey.

In the middle Silurian of the central United States are several species of camerate crinoids that have variously been referred to *Saccocrinus, Periechocrinus, Carpocrinus* (*"Habrocrinus"*), and *Aorocrinus.* These species cannot be assigned to any described genus. The new genus *Stiptocrinus* is here proposed for their reception.

Stiptocrinus, n. gen.

Genotype.—Stiptocrinus spinosus, n. sp.

Generic diagnosis.—

Crown. The genus is represented by a considerable number of thecae, but the arms are unknown except for their proximal portions.

Theca. As seen, specimens attain a maximum height of approximately 40 mm. In general aspect *Stiptocrinus* strongly resembles characteristic species of *Actinocrinus* from the lower Mississippian. There is a pronounced tendency toward lobation, and the proportions of the cup to tegmen are similar. The dorsal cup is high, averaging about 70 percent of the over-all height of the theca. The dorsal cup ranges from subturbinate to subglobose in shape, with somewhat depressed interradial areas. The tegmen is low and usually has well-defined depressed interambulacral areas. The thecal plates are heavy and typically tumid. The plates of the dorsal cup may be ornamented by discrete subspinous processes, irregular vermicular ridges, or fairly regular radiating ridges. In *S. nodosus* the plates of the dorsal cup are all strongly nodose.

BB. Three subequal elements, usually moderately large and prominent.

RR. In most species the height and breadth of the plates are approximately the same. In some species the height is greater than the breadth. In *S. spinosus* the height is as much as one-third greater than the breadth.

IBrr. The first primibrach is usually considerably smaller than the radial, and the primaxil still smaller.

IIBrr. At least two and in some cases three secundibrachs may be considered as incorporated in the cup. As a rule the *IIBrr* diverge from the wall of the theca, giving the genus its typical lobate form. The secundibrachs are very stout and the two ranges are typically closely appressed laterally so far as preserved. In species where there is a small intersecundibrach, the brachials enclose it completely.

Interradii. The posterior interradius is very much larger than the others. The primary anal is equal in size to the *RR* and is followed by the usual batocrinoid range of three plates. Distad the plates have a somewhat irregular arrangement. There is a median series of plates decreasing in size distad. In most specimens there are but two or three plates in this vertical series, but in a few cases there are more. The posterior interradius reaches its maximum breadth at the level of the third range, which consists of five plates. In the other interradii the first plate is relatively small, followed by two plates in each of the following ranges.

Tegmen. The tegmen is a low, arched, competent structure. It is composed of numerous small stout plates. The anal tube is excen-

[1] Published by permission of the Director, U. S. Geological Survey. Received December 11, 1945.

tric in position. In all specimens known it has been broken off. Judged by the diameter at the base, it was unusually large for crinoids of this size.

Arms. The maximum number of *IIBrr* found in place in any specimen seen is four in series. At this level the two series of a ray are typically closely united. The structure suggests a radial trunk, such as is found in *Melocrinus*. Indeed, some of the specimens found in the collections had been identified as *Melocrinus*. Distad the rami probably separate. Associated with a crushed theca of uncertain specific affinities are two fragments of what appear to be discrete rami. They are laterally displaced, but seem to belong to the specimen. If such be the case, the rami are stout and uniserial.

Column. The column itself is unknown. From the impression on the basals is appears to have been relatively large. In one specimen the lumen shows clearly. It is pentalobate.

Distribution.—*Stiptocrinus* has been recognized in the Cedarville dolomite of Ohio and Indiana, the Racine dolomite of Illinois, the Laurel limestone of Indiana, and the Decatur limestone of Tennessee. There is a specimen in the Springer collection formerly labeled *Dimerocrinus inornatus* and stated to come from the Waldron of Hartsville, Ind. It is a *Stiptocrinus*. At St. Paul, Ind., the specimens seem to come from several horizons and localities. Unfortunately, the original locality labels were not transcribed when the specimens were put in the collections.

Remarks.—The only genus with which *Stiptocrinus* need be compared is *Periechocrinus*. *Saccocrinus*, as based on the type species *Saccocrinus speciosus*, cannot be separated from *Periechocrinus*. *Periechocrinus* has relatively very thin plates and an incompetent tegmen made up of a great many small plates. The plates of the cup, particularly in the radial series, are typically very high in proportion to the breadth. Many of the plates of the higher ranges of the radial series are incorporated in the cup. The anal tube is a short incompetent structure, usually found flattened down on the tegmen. *Stiptocrinus*, as may be seen in the description given above, differs to a marked degrees in all the characters enumerated.

Species referred to the genus.—

Stiptocrinus benedicti (S. A. Miller), n. comb.

Saccocrinus benedicti S. A. Miller, 1892, p. 29, pl. 5, figs, 1, 2, "Niagara Group, at St. Paul, Indiana" (Laurel limestone).—S. A. Miller, 1894, p. 283, pl. 5, figs. 1, 2.—Springer, 1926, p. 46, pl. 10, figs. 6–10 (*non* figs. 11–14).

Periechocrinus ornatus (Hall) (*pars*), Wachsmuth and Springer, 1897, pl. 51, fig. 7.

Not *Habrocrinus benedicti* Slocom (*non* Miller) (=*Stiptocrinus chicagoensis* (Weller), 1908, p. 295, pl. 87, figs. 6, 7.—Foerste (*non* Miller) (=*Stiptocrinus* sp.), 1917, p. 243, pl. 10, figs. 5a, 5b.

This is apparently the most abundant species of *Stiptocrinus* in the Laurel limestone at St. Paul, Ind. There are 30 or more specimens of the species in the Springer collection, not counting 4 specimens figured by Springer, but here removed from the species. At least 15 of these specimens are in good to excellent state of preservation and represent a considerable range in growth stages.

The maximum height of theca among known specimens is shown by one of Miller's types, which gives 30 mm. Most specimens have a height of 25 mm or less.

The characteristics of the species are well shown by Springer's figures (1926, pl. 10, figs. 6–10). The plates of the dorsal cup, as shown in fig. 7 are incorrectly drawn. The radials appear to be considerably higher than wide. Such is not the case, as the dimensions are nearly equal.

Specimens shown in Springer's figs. 11 and 12 have been removed from *S. benedicti* and placed in a new species, *S. spinosus*. Specimen Fig. 13 represents still another species. As shown in the tegminal view it is deeply lobate. *S. benedicti* is only slightly lobate. The dorsal cup of fig. 13 is unlike that of either *S. benedicti* or *S. spinosus*. Specimen fig. 14 is here described as *S. carinatus*.

Stiptocrinus carinatus, n. sp.

Saccocrinus benedicti Springer (*non* Miller) (*pars*), 1926, pl. 10, fig. 14.

This species is given a name chiefly to record its aberrancy in form and ornamentation. As holotype I choose the specimen figured by Springer, pl. 10, fig. 14. The specimen is a fragmentary dorsal cup, preserving the posterior interradius and three rays. The specimen is somewhat crushed. The tegmen is missing, and the wall of the cup is preserved up to and including the first secundibrachs. A smaller

specimen, not figured, has a complete dorsal cup, preserved to the same level as the larger specimen. This will stand as a paratype. There is another specimen, larger than the holotype, poorly preserved, and partially embedded in matrix.

The cup is broader than high, the small specimen having an average diameter of 15 mm and a height of 12 mm. The walls of the cup diverge more widely than any described species of the genus, excepting *S. nodosus*. The typical plate ornamentation consists of sharp carinae radiating from the center of the plate to each angle. This is unusual, as radiating ridges usually run normal to the faces of the plate. The basals bear irregular vermicular rounded ridges.

The widely expanding walls of the dorsal cup and the stellate ornamentation of the plates readily distinguish this species from any described form.

Horizon and locality.—Laurel limestone, St. Paul, Ind. All three specimens are partially silicified and come from a dolomitic limestone.

Types.—The types are in the Springer collection, United States National Museum. Holotype S 4473; paratype S 4474.

Stiptocrinus chicagoensis (Weller), n. comb.

Periechocrinus chicagoensis Weller, 1900, p. 131, pl. 13, figs. 7, 8, Niagaran, Bridgeport and Joliet, Ill. (Racine dolomite).

Habrocrinus benedicti Slocom (*non* Miller), 1908, p. 295, pl. 87, figs. 6, 7.

This is the largest described species of *Stiptocrinus*, the height of the theca ranging up to 40 mm or more. It is difficult to form an adequate picture of the species. Except for the portion of the exterior figured by Slocom, all we have are internal casts. The *RR* are higher than wide, and the primibrachs are relatively larger than in any other described species. There seem to be no intersecundibrachs.

Because of its large size and the proportions of the plates, it would seem advisable to keep this species distinct.

Stiptocrinus farringtoni (Slocom), n. comb.

Habrocrinus farringtoni Slocom, 1908, p. 296, pl. 87, figs. 1–5, "Niagaran limestone—about 1 mile east of Lemont, Illinois" (Racine dolomite).

Stiptocrinus howardi (S. A. Miller), n. comb.

Saccocrinus howardi S. A. Miller, 1892, p. 30, pl. 5, figs. 3–5, "Niagara Group, at St. Paul, Indiana" (Laurel limestone).—S. A. Miller, 1894, p. 284, pl. 5, figs. 3–5.

Habrocrinus howardi (Slocom), 1908, p. 297.—Foerste, 1917, p. 243.

The validity of this species is questionable. Not having seen the specimen itself, I am not competent to pass judgment. In the Springer collection I have chosen one specimen that may represent this species. In form of theca this specimen resembles *S. benedicti*, and the ornamentation is similar. The theca, however, is strongly lobate, and there are no intersecundibrachs. It does not have the broadly truncate base and subcylindrical cup described by Miller. Indeed, in a hundred or more specimens of *Stiptocrinus* from St. Paul I have seen no specimens corresponding to Miller's.

Stiptocrinus nodosus (Springer), n. comb.

Aorocrinus nodosus Springer, 1926, p. 47, pl. 10, figs. 16, 16a, 16b, "Decatur limestone, Niagaran; below Grandview, 10 miles above Clifton on the Tennessee River, Perry County, Tennessee."

I think there can be little doubt that this species is referable to *Stiptocrinus*. The radial series is not preserved beyond the first secundibrachs, but all the structures shown agree with those of the genus.

Stiptocrinus spinosus, n. sp.

Saccocrinus benedicti Springer (*non* S. A. Miller) (*pars*), 1926, pl. 10, figs. 11, 12.

There are 15 specimens of this species in the Springer collection, two of them figured by Springer as *Saccocrinus benedicti*, as noted above. The specimen illustrated by fig. 11 is chosen as holotype of *Stiptocrinus spinosus*. The other specimen (fig. 12) will stand as a paratype.

This is one of the smaller species of the genus. The theca of the holotype, an adult individual, has a height of 20 mm, which seems to be about average for the species. The paratype, an imperfect specimen lacking the tegmen and *IIBrr*, would have had a height somewhat greater than this.

The theca is strongly lobate, more so than any described species of the genus. The dorsal cup is high, making up about four-fifths the over-all height of the theca. The sides of the cup diverge evenly at an angle of about 45°. The tegmen is low, with strongly depressed interambulacral areas.

In the dorsal cup perhaps the most characteristic feature of the species is the proportionally very large radial, and its considerable excess in height over breadth. In the holotype the average height of the radials is approximately one-third greater than the breadth. The secundibrachs diverge sharply from the wall of the cup, giving the strongly lobate form characteristic of the species. There are no intersecundibrachs.

The ornamentation of the plates of the cup is unlike that of any known species. In the holotype each basal element bears a pair of subspinous processes. In gerontic individuals, such as the paratype, there is a considerable accretion of sterom. The space between the processes is partially filled, and the lateral elevations are extended distad as rounded ridges. Subsidiary spinous processes may also appear. The radials and the primary anal each typically bear a subcentral spinous process. In gerontic forms two or three less elevated nodes appear below the central node, and low rounded ridges may develop. Each of the first primibrachs bears a central node that tends to extend laterally into a ridge. The plates of the interradial series also have more or less sharply defined central nodes. The pronounced lobation, lack of intersecundibrachs, spinous ornamentation, and the relatively narrow straight-sided dorsal cup clearly distinguish *S. spinosus* from *S. benedicti*. The shape of the cup and the ornamentation are quite unlike that seen in *S. howardi*.

Horizon and locality.—Laurel limestone, St. Paul, Ind. Two specimens can be placed more accurately as from the "State House Quarry."

Types.—The holotype and paratype are in the Springer collection, United States National Museum. Holotype S 4471; paratype S 4472.

The following two specimens will be noted merely because of their stratigraphic position and publication. Neither, owing to poor preservation, can be determined specifically.

Stiptocrinus sp.

Habrocrinus benedicti Foerste (*non* Miller), 1917, p. 243, pl. 10, figs. 5a, 5b, "Muncie, Indiana, above the horizon of the Cedarville dolomite."

This is a large species, fully as large as *S. chicagoensis* and similar to that species.

Stiptocrinus sp.

Habrocrinus sp. Foerste, 1917, p. 242, pl. 10, fig. 6, "Cedarville dolomite—Mills Quarry, one mile southwest of Springfield, Ohio."

This specimen is of medium size and strongly lobate. It most nearly resembles *S. spinosus*, but the walls of the cup diverge more widely, and it is much larger than any known *S. spinosus*. The ornamentation seems to consist of irregular vermicular ridges.

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BOTANY.—*New Asiatic species of the legume genus* Campylotropis.[1] P. L. RICKER, Bureau of Plant Industry, Soils, and Agricultural Engineering.

The species of *Campylotropis*, long included in the genus *Lespedeza*, are now generally recognized as composing a separate genus distinguished by flowers single at an axil and the keel geniculate instead of somewhat curved. About 66 valid species are known, which are almost entirely limited to the Provinces of Yunnan and Szechwan in China.

Scarcity of herbarium material and probable destruction of many types in Germany during the war will make adequate treatment of the genus difficult unless satisfactory duplicate types can be found, but from supposed duplicates of type numbers in American herbaria it is evident that there has been a mixup in the distribution of supposedly authentic material in many cases. Most descriptions in question are, however, fairly complete, and between them and the considerable number of sheets of types and paratypes examined it is believed that there is little probability of any of the accompanying 12 new species having been previously described.

Photographs of type sheets and natural size photographs of the flowers, leaves, and pods have been deposited in the herbaria of the New York Botanical Garden, Bailey Hortorium, Arnold Arboretum, Gray Herbarium, and Missouri Botanical Garden, unless the type sheets have been designated in these herbaria; the photographs are available as exchange for type photographs from other large herbaria.

Campylotropis brevifolia Ricker, sp. nov.

Erect shrubs with gray, densely tomentose stems; petioles up to 1 cm long; leaflets obovate to obcordate, up to 12×16 mm, minutely puberulent and dark green above, densely gray-tomentose below; racemes short, few-flowered, axillary and terminal, flowers rose-purple, calyx densely gray-tomentose, 3–4 mm long, teeth acute, about equaling the tube, standard 8–10 mm long, keel and wings shorter; pods unknown.

Frutex erectus, caule griseo-tomentoso. Foliola obovata vel obcordata usque ad 12×16 mm, superne subglaberrima, subter dense griseo-tomentosa. Racemi brevi, axillares, sparsiflori; corolla roseo-purpurea, ca. 8–10 mm longa; calyx dense griseo-tomentosus, 3–4 mm longus, laciniis acutis, tubo subaequilongis.

Type no. (953) 5604, Dr. H. F. v. Handel-Mazzetti, in valley of Yalung River between Datung and Delifu, Szechwan, China, October 14, 1914, in Herbarium of the Arnold Arboretum. Also Szechwan, T. T. Yu, no. 1450, October 20, 1932. Altitude 1,600 m.

Somewhat resembling *C. stenocarpa* (Maxim.) Schindl., but that species has the calyx teeth about twice longer than the tube.

Campylotropis filipes Ricker, sp. nov.

Shrubby, few branches, stems erect, striate, sparingly appressed, pubescent to glabrous, 10–30 dm tall. Stipules linear-lanceolate, 5–6 mm long; petioles 2.5–3 cm long; leaflets narrowly elliptic, lateral nearly sessile, sparingly pubescent to glabrous above and below, .4–1.3×2.2–5.2 cm, acute to obtuse at both ends, mucronate. Peduncles about 1.5 cm long; racemes terminal and axillary, 3–4 cm long; pedicels slender, appressed pubescent, 7–8 mm long; calyx hirsute, about 3 mm long, teeth mucronate, about equaling the tube; flowers reddish-purple (note on specimen); pods glabrous, margin ciliate, oblanceolate, about 4×9 mm.

Suffrutex, ramis paucis, caule erecto, 10–30 dm alto. Foliola angusto-elliptica, subsessilia, .4–1.3×2.2–5.2 cm. Racemi axillares et terminales, 3–4 cm longi. Calyx hirsutus, ca. 3 mm longus, laciniis mucronatis, tubo subaequilongis. Corolla ignota. Legumen oblanceolatum ca. 4×9 mm, margine ciliato.

Type no. 14832, T. T. Yu, Muli, Guhtzum, Yunnan, China, December 4, 1937, in Herbarium of the Arnold Arboretum. Altitude 3,100 m.

In the absence of the flowers the single fruiting pedicel at an axis distinguishes this from *Lespedeza*, and the habit and leaflets are entirely different from anything seen elsewhere in the genus *Campylotropis*.

[1] Received December 14, 1945.

Campylotropis gracilis Ricker, sp. nov.

Slender shrubs, branches erect to decumbent, new growth angular and densely tomentose, older growth becoming woody and sparingly tomentose; leaves thin, chartaceous, sparingly pubescent above, glabrous and appressed-pubescent below, petioles equaling the leaflets; leaflets oblanceolate to elliptic, up to 2.1×5 cm, apex retuse and mucronate, terminal leaflet larger; infloresence axillary and terminal, up to 6 cm long, peduncle tomentose, pedicels slender, tomentose, 0.5–1 cm long; flowers few, (rosy?); calyx 3–4 mm long, tomentose, teeth linear-lanceolate, about equaling the tube; standard about 1.1 cm long, equaling the keel, wings shorter; pod unknown.

Frutex gracilis, ramis erectis vel decumbentibus, angulatis, dense tomentosis. Foliola elliptica vel oblanceolata usque ad 2.1×5 cm, apice retusa et mucronata. Flores pauci, calyx 3–4 mm longus, tomentosus, laciniis linearilanceolatis, tubum subaequantibus. Vexillum ca. 1.1 cm longum. Carina alas superans.

Type no. 6508, Dr. A. Henry, Hupeh, China, 1885–88, in Gray Herbarium.

Most nearly resembling *C. polyantha* (Fr.) Schindl., but that species has leaflets that are glabrous above and shorter; it also has longer calyx teeth and more spreading pubescence on the pedicels.

Campylotropis hersi Ricker, sp. nov.

Shrub with long, erect, unbranched new growth (all seen) and closely and finely appressed-pubescent stems; stipules subulate, 4–5 mm long, petioles up to 2 cm long; leaflets elliptic to ovate, apex obtuse or acute to emarginate and mucronate; racemes axillary and terminal, 4–5 mm, cone-like buds only developed. Flowers and pods unknown.

Frutex erectus, ramis dense appresse pubescentibus. Stipulae subulatae, 4–5 mm longae. Petioli usque ad 2 cm longi, foliola elliptica usque ovata, apice obtuse usque acuta vel emarginata. Racemi axillares et terminales.

Type no. 1601, Joseph Hers, Nankow Pass, northern Chihli, China, August 15, 1921, in Herbarium of the Arnold Arboretum.

Campylotropis huberi Ricker, sp. nov.

Erect shrubs, with stem many-angled, appressed-canescent. Leaves membranaceous, stipules subulate, canescent, 4 mm long; petioles 2–4 cm long, canescent; leaflets elliptic-oblong, narrowly obtuse at both ends, up to 1.7×5 cm, sparingly puberulent to glabrous above, appressed grayish-pubescent below. Racemes axillary and terminal, peduncle up to 6 cm long with spreading fuscous pubescence, flowers crowded on the upper half; calyx 3 mm long, teeth acute, 1 mm long; corolla purple, 10–11 mm long, wings 9–11 mm long. Pod unknown.

Frutex erectus, caule multiangulato, adpresse canescente. Folia membranacea; stipulae subulatae, canescentes, ca. 4 mm longae; petioli 2–4 cm longi; foliola elliptico-oblonga usque ad 1.7×5 cm. Racemi axillares et terminales, pedunculo usque ad 6 cm longo; calyx 3 mm longus, laciniis acutis 1 mm longis; corolla purpurea, 10–11 mm longa, alis 9–10 mm longis.

Type no. B46=746, W. Huber, June 16, 1868, ex Herbarium Meisner, in Herbarium of the New York Botanical Garden. No locality given but probably vicinity of Yunnan or Szechwan, as most of the known species are from that area.

The shape of the leaflets is quite characteristic and distinct from that of any species seen.

Campylotropis longepedunculata Ricker, sp. nov.

Erect shrub 1.2 m tall, young stems angular and densely tawny hirsute; petioles about half the length of the leaflets, densely hirsute; leaflets elliptic to oblong-elliptic, up to 3.2×6.7 cm long, dark green and glabrous above, light green and closely pubescent below, apex retuse and mucronate; racemes terminal and axillary, peduncles mostly 11–19 cm long; flowers purple, numerous on the upper half, pedicels slender, hirsute, mostly 5–8 mm long; calyx hirsute, 4–5 mm long, teeth acuminate, equaling or slightly longer than the tube; standard 8–9 mm long, keel and wings nearly equaling the standard; pods about 4×10 mm, elliptic, acute, hirsute.

Frutex erectus, caule angulato, dense fulvo-hirsuto; petioli foliolis dimidio breviores, dense hirsuti; foliola elliptica vel oblongo-elliptica usque ad 3.2×6.7 cm, apice retusa et mucronata. Calyx hirsutus, 4–5 mm longus, laciniis acuminatis, tubo subaequilongis; corolla purpurea, 8–9 mm longa. Legumen ca. 4×10 mm, ellipticum, acutum, hirsutum.

Type no. 6108, Y. Tsiang, Lung-bing, Tuyun, Kweichow, China, July 28, 1930. Also no. 8407, Y. Tsiang, Lungli, Kweichow, China, July 4, 1930. Both in Herbarium of the Arnold Arboretum.

Most nearly resembling *C. grandifolia* Schindler, but that species has the young growth glabrous or sparingly pubescent, the leaflets sparingly pubescent below, the inflorescence with spreading pubescence, and the pods obtuse.

Campylotropis mortolana Ricker, sp. nov.

Erect shrub with branches at first appressed-pubescent; lower petioles as long as the leaves; stipules linear-lanceolate, about 3 mm long; leaflets elliptic to obovate, apex and base often acute, up to 2×4.5 cm, glabrous above, sparingly pubescent to glabrous beneath; inflorescence of short terminal (and axillary?) racemes; pedicels stout, 3–4 mm long, with spreading pubescence; calyx about 3 mm long, teeth 1 mm long, broadly acute; standard about 1 cm long (purple or violet?), keel 1 cm long, wings somewhat shorter; pods unknown.

Frutex erectus, ramis adpresse pubescentibus. Stipulae lineari-lanceolatae, ca. 3 mm longae; foliola elliptica vel obovata, apice et basi saepe acuta, usque ad 2×4.5 cm, superne glabra, subter parce pubescentia. Calyx ca. 3 mm longus, laciniis acutis, 1 mm longis; corolla ca. 1 cm longa.

Type sheet in Arnold Arboretum from herbarium of Camillo Schneider collected at La Mortola Garden in Italy, August 1903, bearing the name *Indigofera macroptera* which suggests that the labels were mixed in mounting. The species is most certainly from China and probably from the Provinces of Yunnan or Szechwan which are the centers of distribution of most of the species of Campylotropis.

The species most nearly suggests *C. prainii* but we have not seen the frequently acute apex leaflets in that species. The petioles and pedicels in that species are long and slender, the leaflets usually much darker colored, at least in drying, and the inflorescence not so compact, and it has many conspicuous long linear-lanceolate bractlets not found in *C. mortolana*.

Campylotropis nepalensis Ricker, sp. nov.

Small erect shrubs with much branched tomentose stems; leaves very short petioled (2–3 mm); stipules 3 mm long, linear-lanceolate; leaflets thick, broadly cuneate, apex obtuse, mucronate and often retuse, up to 10×15 mm, glabrous above and veins very prominent, reticulated, tomentose beneath. Inflorescence in short axillary racemes, pedicels slender, ciliate, about 5 mm long; flowers (rose purple?), calyx hirsute, 4–5 mm long, teeth lanceolate, about equaling or somewhat longer than the tube, standard 8–10 mm long, keel and wings shorter; pod unknown.

Suffrutex, ramosissimus, tomentosus. Stipulae lineari-lanceolatae, 3 mm longae; foliola coriacea, late cuneata, apice obtusa, mucronata, saepe retusa, usque ad 10×15 mm, superne glabra, subter tomentosa. Calyx hirsutus, 4–5 mm longus, laciniis tubo subaequilongis; corolla (roseo-purpurea?) 8–10 mm longa, carina et alis longior.

Type no. 59, Bis Ram, Chaumala, West Nepal, India, March 23, 1929, in Herbarium of Arnold Arboretum.

The general appearance of the plant resembles *C. stenocarpa* (Klotzsch) Schindler, which has long, terminal, axillary racemes of flowers, conspicuous close, broadly lanceolate, hirsute bractlets, and with the leaflets less conspicuously reticulated and much more densely tomentose beneath.

Campylotropis purpurascens Ricker, sp. nov.

Shrubs 9–15 dm tall, branches striate, densely velvety. Stipules linear-lanceolate, 6–7 mm long; petioles up to 2 cm long; leaflets coriaceous, elliptic, mucronate, velutinous above, densely sericeous below, up to 1.9×2.8 cm. Racemes arcuate, up to 8 cm long; rhachis hispid, flowering nearly to the base. Calyx about 3 mm long, appressed-pubescent, teeth arcuate, about equaling the tube; corolla 7–8 mm long, purplish-blue. Fruits unknown.

Frutex 9–15 dm altus, ramis striatis, dense velutinis. Stipulae lineari-lanceolatae, 6–7 mm longae; petioli usque ad 2 cm longi; foliola coriacea, elliptica, mucronata, superne velutina, subter dense sericea, usque ad 1.9×2.8 cm. Calyx ca. 3 mm longus, adpresse pubescens, laciniis acutis, tubo subaequilongis; corolla 7–8 mm longa, purpureo-coerulea.

Type no. 17571, T. T. Yu, Shunning, Hila, Yunnan, China, September 9, 1938, in Herbarium of the Arnold Arboretum. Not closely resembling any other species of *Campylotropis*,

but the leaf shape and raceme branches suggest *Lespedeza thunbergii* (Vogel) Koehne, except for the velvety and silky characters of the leaflets.

Campylotropis reticulata Ricker, sp. nov.

Erect shrub, about 6 dm tall, branches angular, densely tomentose; leaves glabrous and with conspicuous, small reticulations above, appressed-pubescent below; stipules linear-lanceolate, villose, 4 mm long; petioles villose, up to 1.5 cm long; leaflets oblanceolate to elliptic, coriaceous, up to 1.2×2.2 cm; inflorescence axillary and terminal, racemes about equaling the peduncle, 2–3 cm long; flowers pink; calyx hirsute, about 3 mm long, teeth linear-lanceolate, equaling the tube; standard about 8 mm long, equaling the keel, wings shorter; pods elliptic, acute, hirsute, margin closely ciliate, about 8 mm long.

Frutex erectus, ca. 6 dm altus; ramis angulatis, dense tomentosis. Foliola oblanceolata usque elliptica, coriacea, usque ad 1.2×2.2 cm. Calyx hirsutus, ca. 3 mm longus, laciniis linearis-lanceolatis tubo aequilongis; vexillo ca. 8 mm longo, carina aequilongo, alis brevioris. Legumen ellipticum, acutum, hirsutum, marginum ciliatum, ca. 8 mm longum.

Type no. 9626A, A. Henry, Meng-tsze, Yunnan, China, in U. S. National Herbarium.

C. reticulata most nearly resembles *C. eriocarpa* (DC.) Schindl. but is at once distinguished by the conspicuous small, oval reticulations of the leaflets. In *C. eriocarpa* the reticulations are less conspicuous, and much more elongated, and the leaflets are darker colored. Henry's no. 9626, with appressed-pubescent stems, which is mounted on the same sheet, is *C. neglecta* Schindl.

Campylotropis smithi Ricker, sp. nov.

Shrubby, branches appressed-pubescent, many angled; petioles nearly as long as the leaves, stipules lanceolate; leaflets elliptic, up to 1.1×1.8 cm, glabrous above, pubescent beneath; racemes terminal and axillary, up to 6 cm long; flowers rose-purple; pedicels up to 5 mm long, calyx hispidulous, about 5 mm long, teeth lanceolate, about equaling the tube; standard about 1 cm long, keel and wings shorter; pods unknown.

Suffrutex, ramis adpresse pubescentibus, multiangulatis. Folia petiolo subaequilonga; stipulae lanceolatae; foliola elliptica usque ad 1.1×1.8 cm, superne glabra, subter pubescentia. Flores roseo-purpurea, pedicelli usque ad 5 mm longi; calyx ca. 5 mm longus, hispidulus, laciniis lanceolatis tubo subaequilongis, vexillum ca. 1 cm longum, carina et alis breviore.

Type no. 2268, Harry Smith, near Ta-tien, Szechwan, China, July 2, 1922, in Herbarium of the Arnold Arboretum. A fragmentary specimen with somewhat obovate obtuse pods from Yunnan, T. T. Yu, no. 14885, may belong to this species.

C. smithi suggests a small-leaved form of *C. sargentii* Schindler, but our species has quite a different type of pubescence on the calyx teeth, the flowers are smaller, and the leaflets more densely pubescent below.

Campylotropis wangi Ricker, sp. nov.

Erect shrub, stems glabrous below, sparingly appressed pubescent above; petioles about 1 cm long, appressed-pubescent, leaflets elliptic up to 1.2×3.3 cm, glabrous above, sparingly pubescent below; racemes axillary and terminal, glandular-tomentose, peduncles about equaling the leaves, pedicels 4–6 mm long; calyx strigose, 4–5 mm long, teeth acuminate, about equaling the tube; flowers pale purplish to reddish, about 1 cm long, keel and wings equal, standard about 9 mm long; pods elliptic, about 4×9 mm, puberulent, margin ciliate.

Frutex erectus, caulibus subter glabris, superne sparse adpresse pubescentibus. Petiolus ca. 1 cm longus; foliola elliptica usque ad 1.2×3.3 cm, superne glabra, subter sparse pubescentia. Calyx strigosus, 4–5 mm longus, laciniis acuminatis tubo subaequilongis. Flores pallido-purpurei usque rubescentes, ca. 1 cm longi, aliis carinam aequantibus, vexillo ca. 9 mm longo. Legumen ellipticum ca. 4×9 mm, puberulentum, margine ciliata.

Type no. 70331, C. W. Wang, A-tun-tze, Yunnan, China, 1,300–3,000 m elevation, September 1935, in Herbarium of the Arnold Arboretum, and probably no. 63456, C. W. Wang, Ta-li Hsien, May 1935.

Somewhat resembling *C. capillipes* (Franch.) Schindler, but leaflets more elongated and peduncles and pedicels with spreading glandular pubescence instead of appressed.

ENTOMOLOGY.—*Synoptic revision of the United States scarab beetles of the subfamily Dynastinae, No. 3: Tribe Oryctini (part).*[1] LAWRENCE W. SAYLOR, Research Associate, California Academy of Sciences.

This paper is the third in the series covering the United States dynastine scarab beetles and includes the four genera differentiated in the following key:

1. Apex clypeus acute and definitely *bidentate*, the teeth often worn and nearly obsolete..2
   Apex clypeus acute, either sharply or bluntly so, but never bidentate.....3
2. Mandibles definitely *tridentate* externally, the basal tooth often worn and barely visible; thorax not more than two-thirds the length of the elytra; color rufous to rufocastaneous or rufopiceous.....*Ligyrus* Burmeister
   Mandibles *bidentate* externally (caution: examine from below and laterally to avoid counting the lacinia teeth as third teeth of the mandible); thorax about three-fourths the length of the elytra; color always black. *Euetheola* Bates
3. Thorax never foveate; mandibles large and evenly rounded externally, never toothed; coloration piceous to piceocastaneous, rarely rufocastaneous.....*Aphonides* Rivers
   Thorax always foveate at midapex, and with midapical tubercle; mandibles tridentate externally; coloration bright rufous and strongly shining.....*Oxygrylius* Casey

Genus **Ligyrus** Burmeister

Ligyrus Burmeister, 1847, p. 542; Casey, 1915 p. 178; Ritcher, 1944, p. 25 (larvae); Hayes, 1917, p. 253 (biology).
Tomarus Erichson, 1847, p. 95.
Ligyrodes Casey, 1915, p. 178; Arrow, 1937, p. 35.
Grylius Casey, 1915, p. 189.
Anagrylius Casey, 1915, p. 204.
Ligyrellus Casey, 1915, p. 206.
Euligyrus Casey, 1915, p. 185.

This American genus includes 52 species, according to Arrow (1937), but many of them are not valid; of the 37 names now being used for our United States species (30 of them Casey's), there are in reality only six valid species, one of these being formerly known only from Mexico and the other a West Indian species probably recorded from the States by error.

KEY TO UNITED STATES LIGYRUS

(Males have last abdominal sternite emarginate apically)

1. First elytral interval very wide next to scutellum, and very smooth, usually entirely impunctate, rarely with a dozen or so very minute and highly scattered punctures; male front claw simple and not enlarged; color rufous to piceous; size large (18–27 mm); known from Baja California and Mexico, to Honduras; rare in Arizona (Fig. 1, *i*).....*laevicollis* Bates
   First elytral interval always coarsely and moderately densely punctured.....2
2. Most of discal thoracic area very smooth and with scattered, very fine punctures; clypeal base with two widely separated tubercles; male front claws simple; color piceous; size large (21–25 mm); Florida (Fig. 1, *j*). *subtropicus* Blatchley
   Size variable, rarely as large as 18 mm; puncturation of thorax very variable but center basal area always with at least a dozen or so coarse punctures.....3
3. Basal clypeal carina always erect and distinct (unless worn) and never interrupted at middle; male front claws always *simple* and not enlarged; pygidium very densely, finely, and scabrosely punctate both near and *at* basal corners and often the same along basal margin; rest of pygidial disc polished and finely punctate but very variable in density of puncturation; mid-apex of thoracic disc almost always with a small fovea immediately behind the small marginal tubercle; widespread over United States, Baja California, and northern Mexico (genitalia, Fig. 1, *e*)...*gibbosus* (DeGeer)
   Basal carina of clypeus always noticeably interrupted at middle, and usually widely so, frequently appearing bituberose; male front claws simple or enlarged; pygidial puncturation very variable, if scabrose then very grossly so.....4
4. Male front claws simple and not enlarged; pygidial puncturation at corners very coarse but punctures usually not contiguous except right at corners, puncturation of disc very coarse and only moderately dense; West Indies (probably not United States) (genitalia, Fig. 1, *f*).....*cuniculus* Fabricius
   Male front claws *enlarged* and the inner claw larger and reflexed; pygidial puncturation of female not as above.....5
5. Pygidial puncturation exceedingly dense and scabrose over nearly all the disc, only a small midapical area less densely punctured; Eastern United States, rare to Arizona (genitalia, Fig. 1, *h*).....*relictus* Say
   Pygidial puncturation very coarse but not at all dense and with smooth areas between the punctures even right at the pygidial basal angles; United States (Texas) and Mexico to Costa Rica (genitalia, Fig. 1, *g*)..*sallei* Bates

[1] Received September 27, 1945.

Ligyrus relictus Say

Ligyrus relictus Say, 1825, p. 194; Horn, 1875, p. 143; Casey, 1915, p. 183 (*Ligyrodes*); Ritcher, 1944, p. 22 (*Ligyrodes*) (larvae).
Ligyrodes clypealis Casey, 1915, p. 181. (New synonymy.)
L. parviceps Casey, 1915, p. 182. (New synonymy)
L. quadripennis Casey, 1915, p. 182. (New synonymy.)
L. vernicollis Casey, 1915, p. 182. (New synonymy.)
L. dawsoni Casey, 1924, p. 334. (New synonymy.)

Rather widely distributed in the midwestern and eastern States; I have seen specimens from Rhode Island, New Jersey, Pennsylvania, Iowa, Indiana, Kansas, and Nebraska. It occurs also rarely west of Kansas and I have seen specimens from Arizona. The larvae feed in old manure piles and soils rich in humus. The male enlarged front claw, the large size, and dark color will readily place the species over much of its range. The genus *Ligyrodes* erected for this species by Casey is not valid, since the characters apply only to the male sex and so females could not be properly placed.

Ligyrus sallei Bates

Ligyrus sallei Bates, 1888, p. 318.
L. aztecus Casey, 1915, p. 184. (New synonymy.)
L. propinquus Casey, 1915, p. 183. (New synonymy.)

This common Central American (Mexico, Guatemala, Nicaragua, and Costa Rica) species occurs sparingly in the United States; I have seen specimens from Brownsville, Tex. It can be confused in the male only with *relictus*, since both have the enlarged front claw, but the male genitalia are quite different, and the color of *sallei* is more rufous and more highly polished.

Ligyrus cuniculus (Fabricius)

Geotrupes cuniculus Fabricius, 1801, p. 20.
Heteronychus tumulosus Burmeister, 1847, p. 101; Bates, 1888, p. 315 (*Ligyrus*); Casey, 1915, p. 205 (*Anagrylius*); Arrow, 1900, p. 181 (*Ligyrus*).
Ligyrus antillarum Beauvois, 1805, p. 104.

This common West Indian species was said to be from "Nord-America, Sud-Carolina" and "Westindien, St. Domingo," and the original description was based on a specimen obtained from a dealer. Since the species is well known in the West Indies but has apparently not since been taken in the United States, it is time to remove it from our lists. Should it ever occur, the male genitalic drawings will readily place the species. Bates records it from Mexico, British Honduras, and South America, but these records may refer to other, allied species.

Ligyrus gibbosus (DeGeer)

Scarabaeus gibbosus DeGeer, 1774, p. 322; Casey, 1915, p. 204 (*Ligyrus*); Ritcher, 1944, p. 25 (larvae) (*Ligyrus*); Comstock, 1880, p. 274 (biology); Hayes, 1917, p. 253 (biology).
Podalgus variolosus Burmeister, 1855, p. 121.
P. juvencus Burmeister, 1855, p. 121.
Geotrupes juvencus Fabricius, 1775, p. 32.
Ligyrus juvencus Burmeister, 1855, p. 542.
L. morio LeConte 1848, p. 20; Horn, 1875, p. 143.
Bothynus obsoletus LeConte, 1848, p. 87. (New synonymy.)
B. neglectus LeConte, 1848, p. 87. (New synonymy.)
Ligyrus puncticauda Casey, 1915, p. 195. (New synonymy.)
L. arizonensis Casey, 1915, p. 201. (New synonymy.)
L. brevipes Casey, 1915, p. 202. (New synonymy.)
L. breviusculus Casey, 1915, p. 196. (New synonymy.)
L. lacustris Casey, 1915, p. 196. (New synonymy.)
L. californicus Casey, 1915, p. 203. (New synonymy.)
L. laticollis Casey, 1915, p. 203. (New synonymy.)
L. curtipennis Casey, 1915, p. 199. (New synonymy.)
L. effetus Casey, 1915, p. 200. (New synonymy.)
L. farctus Casey, 1915, p. 200. (New synonymy.)
L. laetulus Casey, 1915, p. 197. (New synonymy.)
L. laevicauda Casey, 1915, p. 202. (New synonymy.)
L. laticauda Casey, 1915, p. 197. (New synonymy.)
L. longulus Casey, 1915, p. 193. (New synonymy.)
L. parallelus Casey, 1915, p. 194. (New synonymy.)
L. remotus Casey, 1915, p. 194. (New synonymy.)
L. rubidus Casey, 1915, p. 198. (New synonymy.)
L. lucublandus Casey, 1915, p. 199. (New synonymy.)
L. scitulus Casey, 1915, p. 203. (New synonymy.)
L. spissipes Casey, 1909, p. 283. (New synonymy.)
L. texanus Casey, 1915, p. 195. (New synonymy.)
L. virginicus Casey, 1915, p. 193. (New synonymy.)
L. bicorniculatus Casey, 1915, p. 198. (New synonymy.)

The great variability in size, color, and sculpturing, as well as the worn surface commonly found in this species due to its digging habits (giving the specimens a superficially

different appearance), probably was instrumental in causing Casey to name every trifling variant. The specimens also vary greatly depending on the richness of the food supply in the larval state; thus I have seen large series in which the specimens were all much reduced in size and very similar, but which had all been collected soon after emergence from a small

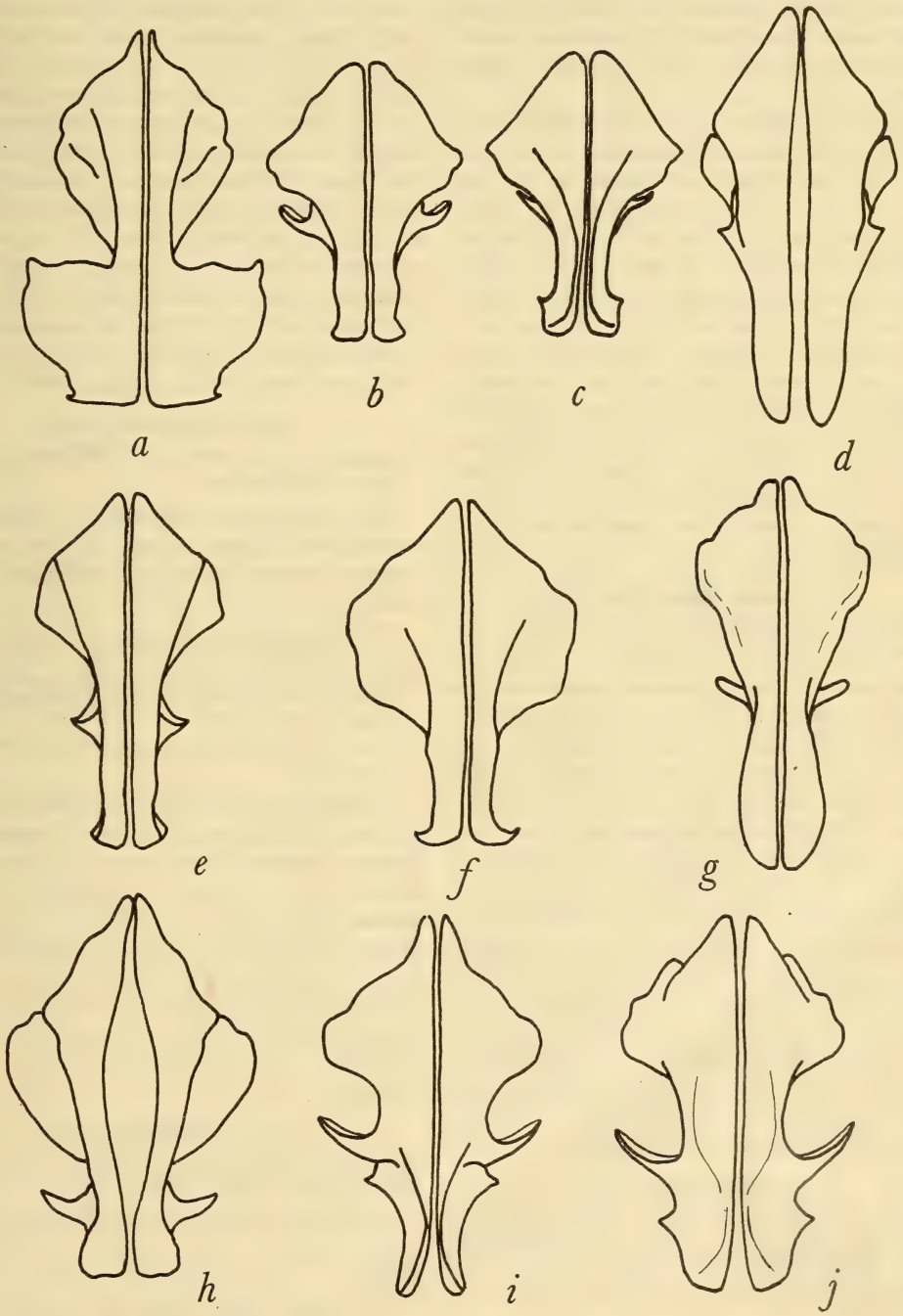


FIG. 1.—Male genitalia: *a, Oxygrylius ruginasus; b, Euetheola rugiceps; c, E. subglabra; d, Aphonides dunnianus; e, Ligyrus gibbosus; f, L. cuniculus; g, L. sallei; h, L. relictus; i, L. laevicollis; j, L. subtropicus.*

manure pile where the food (when they were larvae) had been very scanty; others taken from rich soil are frequently large and dark-colored. I have studied over 1,300 specimens of this species, including all Casey's types; these ranged from Baja California and northern Mexico throughout nearly the entire United States.

Commonly known as the carrot-muck beetle, this species breeds in all types of soil rich in organic matter, and both adults and larvae are known to feed underground on many plants; some of the latter are of considerable economic importance, as for example sugar-beets, potatoes, carrots, and other root vegetables, as well as the well-known rubber substitute *Guayule*. Owing to the digging habits the foretibia and head parts are frequently greatly worn; I have seen dozens of examples in which the foretibia were reduced to a mere stub of one-fourth their former length (all teeth and tarsi completely worn away), and the apical clypeal teeth and head carina completely worn smooth.

Ligyrus subtropicus Blatchley

Ligyrus subtropicus Blatchley, 1922, p. 30.
L. blatchleyi Cartwright, 1944, p. 34. (New syn.)

Known only from Florida (commonest at Miami). Cartwright in his description and discussion of *blatchleyi* in the final analysis gives only one character for the separation of his species from *subtropicus* and that is the punctation of the thoracic impression. In my topotype series from the original type series and collected by the same collector, there is an individual that exactly matches Blatchley's description of his unique female from Dunedin, Fla.; he says the thoracic depression is punctate with fine punctures as fine as the rest of the thoracic punctation, and from studies of many hundreds of *Ligyrus* I have noted that this character is just as variable in really large series as are the clypeal differences, and I am forced to consider these as one species.

Ligyrus laevicollis Bates

Ligyrus laevicollis Bates, 1888, p. 316; Schaeffer, 1909, p. 384; Casey, 1915, p. 190 (*Grylius*); Cartwright, 1944, p. 35.
L. bryanti Rivers, 1891, p. 97; Casey, 1915, p. 190 (*Grylius*).

Schaeffer was the first to synonymize *bryanti* and *laevicollis*, and rightfully so. Casey then resurrected the species, and, *bryanti* being rare in collections, no one has studied it adequately since. I have examined and dissected series including small, rufous, highly polished specimens from Baja California measuring 18 mm long, to large piceous or black, semidull specimens as large as 28 mm, including part of River's original series, and all the specimens are the same in all essential characters, including the male genitalia. It has been seen from Baja California and west coastal Mexico as far south as Acapulco; also recorded by Bates as far south as British Honduras. I have seen one female, 29 mm long, from Phoenix, Ariz. (August), which other than the size is exactly the same as Baja California specimens. The smoothness of the impunctate first elytral interval is very characteristic of this species.

Genus **Oxygrylius** Casey

Oxygrylius Casey, 1915, pp. 178, 208; Ritcher, 1944, p. 27 (larvae).

Only one species belongs in this genus, which is valid since the apex of the clypeus is sharply pointed (and thus unidentate) in both sexes.

Oxygryilus ruginasus (LeConte)

Ligyrus ruginasus LeConte, 1856, p. 20; Horn, 1875, p. 143; Casey, 1915, p. 209 (*Oxygrylius*); Bates, 1888, p. 316.
Oxygrylius peninsularis Casey, 1915, p. 209. (New synonymy.)

I have examined large series from all parts of Baja California, northern Mexico and Sonoran regions (Posa and Los Mochis in Sinaloa), New Mexico, and Airzona; also recorded from California. Rare in the United States, very common in Baja California from June through October; in one series of 216 specimens from Baja California, all specimens possess both the thoracic fovea and tubercle, and differ among themselves mainly in size and color.

Genus **Aphonides** Rivers

Aphonides Rivers, 1889, p. 6; Casey, 1915, p. 230.
Anoplognatho Rivers, 1889, p. 101.

One species only is known of this genus, and nothing seems to be known of the earlier stages.

Aphonides dunnianus (Rivers)

Anoplognatho dunnianus Rivers, 1889, p. 102; Casey, 1915, pl 229.

An unusual, uncommon, and aberrant species. The very large and externally rounded mandibles, the very high transverse clypeal carina, the very dense and long clypeal margin of hairs, and cribrately punctate mentum (ligula), with its dense and long hairs, readily distinguish the species. The female pygidium is large and transversely tumid at the middle; that of the male is very large and evenly convex. The species is known only from Arizona and Texas but will probably prove to occur in New Mexico and northern Mexico also. The males appear to be quite rare, even more so than the females. Small female *Strategus cessus* may be distinguished from females of this species by their thoracic fovea and square mandibles, and they also have an interrupted basal clypeal carina.

Genus **Euetheola** Bates

Euetheola Bates, 1888, p. 314; Casey, 1915, pp. 178, 186.

Five species of *Euetheola* have been described, of which only two occur in the United States. The genus is close to *Ligyrus*, but the species are more oblong-parallel, the thorax is noticeably longer, and the mandibles when viewed from above are only bidentate. The male front tarsi in *rugiceps* are enlarged but small and simple in *subglabra*.

Euetheola rugiceps (LeConte)

Bothynus rugiceps LeConte, 1856, p. 21; Casey, 1915, p. 187 (*Euetheola*); Baerg and Palm, 1932, p. 207 (biology, also many other references, see Arrow, 1937, p. 36); Ritcher, 1944, p. 24 (larvae).

This sugarcane beetle, or rough-headed cornstalk beetle, is very commonly and widely distributed in the Southeastern States. I have seen specimens from Georgia, Kentucky, and Texas. Phillips and Fox (1924) indicate that vegetable matter in poorly drained, or dark and heavy soils is the main larval habitat, as well as grasslands. The species may also attack corn and cornstalks. The male genitalia are close to those of *Ligyrus gibbosus*, but the parameres are shorter and the lateral teeth are larger and more reflexed.

Euetheola subglabra (Schaeffer)

Ligyrus subglabra Schaeffer, 1909, p. 383; Casey, 1915, p. 188 (*Euetheola*).

Differs from *rugiceps* mainly in the practically impunctate (punctures minute and discernible only under high magnification) thoracic disc, as well as by the second and third alternate elytral intervals having a single row of punctures rather than being confusedly punctate. I have seen a single male from Sinaloa in northern Mexico, collected in July; the species was described from a unique specimen from Nogales, Ariz., but to my knowledge it has not since been taken in the United States. The species is very distinct in the genus.

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ENTOMOLOGY.—*Four new species of mosquitoes from Okinawa (Diptera: Culicidae).*[1]

RICHARD M. BOHART, Lieutenant, H(S), U.S.N.R., and ROBERT L. INGRAM, CPhM, U.S.N., U. S. Naval Medical Research Unit No. 2. (Communicated by ALAN STONE.)

During a survey of the northwest coast of Okinawa, Ryukyu Islands, in August and September 1945, four new species of mosquitoes were collected. Type material will be deposited in the U. S. National Museum. All the type localities are in the Hentona District except Shana Wan, which is situated on a bay 4 miles south of the southern limits of the district.

Anopheles (Anopheles) saperoi, n. sp.

Female.—Length 4.5 mm; wing 4.0 mm. Vertex clothed with dark erect scales, some white erect scales medially in front, pale hairlike scales between eyes, remainder of head and its appendages dark, palpus with semi-erect scales, longest toward base where they are almost as long as clypeus. Scutum with sparse brownish hairlike scales, more numerous and whitish anteriorly; scutal integument mostly pale with a distinct unbroken lateral dark margin (Fig. 2); pleuron dark, devoid of scales, with two pale longitudinal stripes visible in some lights. Femora and tibiae dark, latter with an apical ring involving base of tarsi; tarsi with very narrow pale bands covering the joints, indistinct on last two joints of fore- and midlegs. Wing: first humeral spot absent, second humeral spot present but very small, subcostal spot very small, apical spot present, no other costal spots; vein 1 with spots at basal one-fourth, basal one-third and middle (middle spot sometimes absent), as well as apical spot; vein 2 primarily dark, 2.1 with a continuation of apical spot, 2.2 with spot at basal one-third; vein 3 mostly pale except at base and apex; vein 4 primarily dark before fork, 4.1 and 4.2 mostly pale with some dark scales; stem of vein 5 pale with a dark spot before middle, 5.1 mostly pale but dark at base, basal one-third and apex, 5.2 mostly pale on basal three-fourths; vein 6 mostly pale with dark spots at apical two-fifths and at apex; fringe spots absent except one at apex, covering tips of veins 2.1, 2.2 and 3 (Fig. 1). Seventh abdominal sternite with an inconspicuous apical scale tuft.

Male.—Unknown.

Egg.—Length 0.5 mm. Float large, no frill noted. (Figs. 3 and 4 are taken from field sketches made with a dissecting binocular. The eggs were subsequently lost.)

Larva.—Head (Fig. 6): Preclypeal hair 1 slender, curved; inner clypeal hairs long, simple and with bases touching; outer clypeal hair slightly shorter and 4- to 7-branched; posterior clypeal hair nearly as long as outer clypeal hair, simple; frontal and occipital hairs as shown in figure 6; terminal antennal hair 4-branched and extending slightly beyond dorsal saber; antennal hair inserted at basal one-third of shaft, 3- to 4-branched, usually not extending beyond middle of shaft. Antenna spiculate, particularly along inner surface. Thorax (Fig. 5): Prothoracic hair 1 with 3–6 branches; hair 2 with about 8 branches, relatively slender; hair 3 short and simple; metathoracic palmate hair with many well developed branches. Abdomen: Palmate hairs weak on tergite I, well developed with about 20 leaflets on II to VII, the leaflets somewhat slender on II, leaflets sparsely notched and shaped as in Fig. 7; lateral hair of segments I and II stout and many-branched, that of III similar but weaker, that of IV and V slender and bifid near base, that of VI simple; anterior tergal plates small, with concave posterior border, pecten with 8–9 long and 10–11 short teeth (Fig. 8).

Type.—Female, Chizuka, Okinawa, August 24, 1945, collected biting (R. Bohart and R. Ingram collectors).

Paratypes.—Five females, same data as type but collected between August 25 and 31. One female paratype, Euka, August 27, 1945, collected biting (R. Ingram collector). An additional specimen from Chizuka was collected on September 8 and laid eggs in the laboratory. Three larval paratypes were reared to the fourth instar.

Remarks.—This species is related to *barbirostris* van der Wulp, *gateri* Baisas, and

[1] Received November 29, 1945.

umbrosus Theobald. In common with these species it has only two definite spots on the costa, narrow tarsal bands, unbanded hind femur and entirely dark palpus. The adult differs from the other three species in having more prominent hind tarsal bands which cover the joints. Also, it differs from *gateri* in having pale interruptions on the basal one-third of vein 1; from *barbirostris* in having a slightly different wing pattern including an all dark posterior fringe, a continuous dark lateral scutal margin and no conspicuous scale tuft on the seventh sternite; and from *umbrosus* in the larger apical fringe spot and the entirely dark scaled stems of veins 2 and 4. The larva is distinctive in having a very short antennal tuft, a sparsely branched outer clypeal hair and a long single hair 4. It further differs from *gateri* and *umbrosus* by its well developed palmate hairs on the abdomen.

This species is named for Capt. J. J. Sapero (MC), U.S.N., in recognition of his contributions to malariology and his personal encouragement.

Uranotaenia stonei, n. sp.

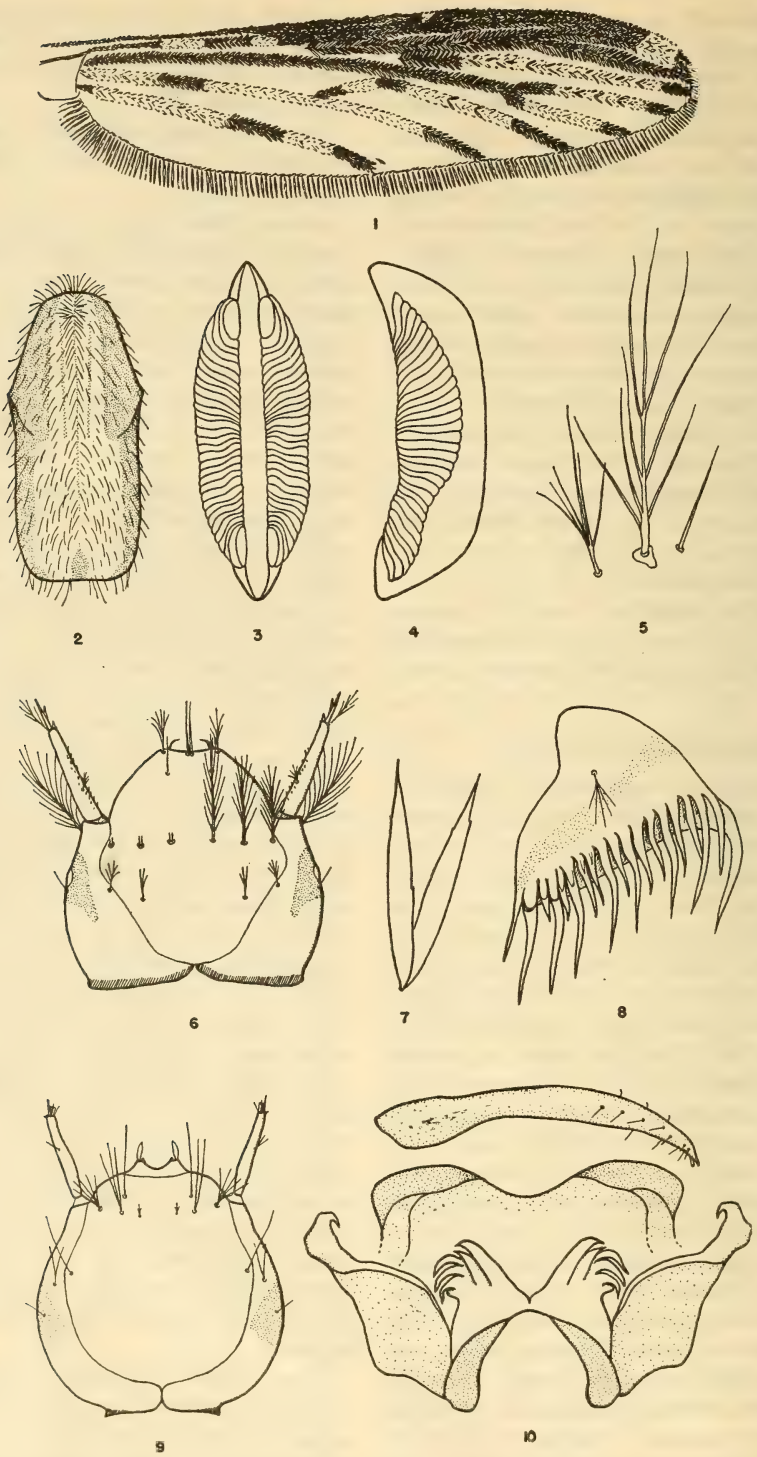
Male.—Length of body 3 mm; length of wing 3 mm. Vertex clothed with light brown broad appressed scales, lighter around eye margins, a sprinkling of upright brown scales; torus bare, light brown; antenna thickly plumose; palpus twice as long as clypeus, light brown; proboscis dark brown, somewhat swollen apically, shorter than fore femur. Integument of thorax light brown; anterior pronotal lobe with a few light gray broad appressed scales; proepimeron with inconspicuous translucent broad appressed scales; scutum with light brown narrow curved scales and many dark stout bristles, a few pale scales around anterior margin; a patch of small translucent scales on upper sternopleuron just below a small dark integumental spot, lower and upper sternopleural bristles well developed, postspiracular area darkened; scutellum with brownish broad appressed scales. Wings entirely dark scaled. Legs dark brown, somewhat paler on femora beneath, front and mid tarsal claws slightly unequal. Dorsum of abdomen clothed with dark brown scales, tergites with inconspicuous pale basal bands on II–VII, venter pale. Genitalia (Fig. 10): Lateral plate of mesosome with five prongs in the position of a partly clenched fist; ninth tergite without bristles along apical margin which is concave; basal lobe of basistyle with 2 stout bristles and several smaller ones.

Female.—About as in male, abdominal bands less distinct. Length of body 3.25 mm; length of wing 3.5 mm.

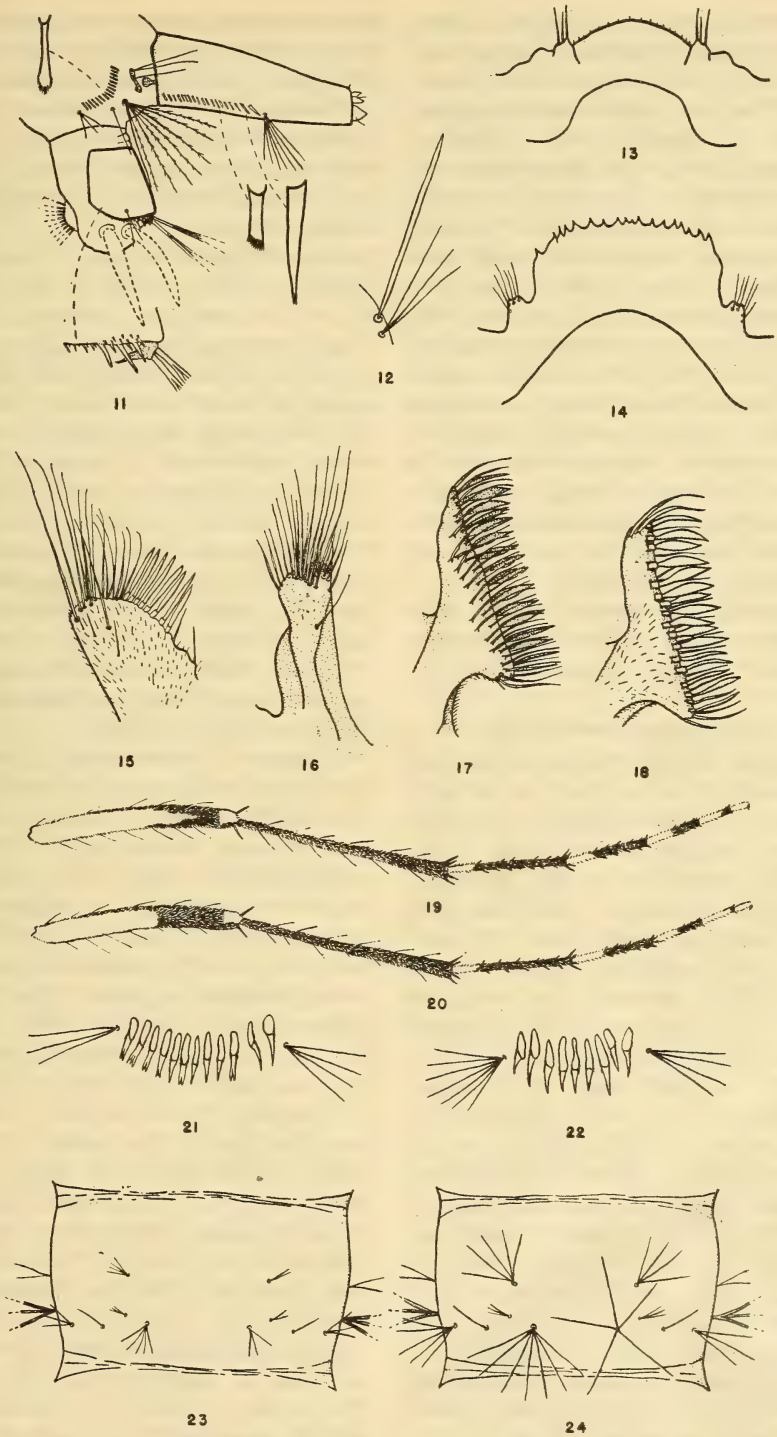
Larva.—Length of body 9.0 mm. Head (Fig. 9): Integument pale; preclypeal spines short, spatulate; head hairs A, B, C, and d placed between antennal bases; lower head hair (B) simple, slender, about as long as antenna; upper head hair (C) 2- to 4-branched and slightly shorter than B; hair d inside and on a level with C, small and 2- to 4-branched; hair A with 5–7 branches; antenna slender with simple or bifid hair at apical two-fifths; mentum triangular with about 17 large teeth. Thorax: Prothoracic hairs 1–3 on a sclerotized tubercle, hair 1 with 2 or 3 branches, hair 2 with 5–7 branches, hair 3 with 2–3 branches; hair 0 small and 4- to 5-branched; hair 4 about 8-branched; hairs 5 and 6 simple, 5 very long; hair 7 with 3–4 branches; mesothoracic and metathoracic submedian hairs with 4 setiform branches; prothoracic pleural submedian hair with 11–14 stout branches. Abdomen: Lateral hairs of segments I and II long and stout, of III–VI long, slender and simple or double; segments III–VI with stout setiform sublateral hairs, these also present on dorsum of I–II and IV–V (Fig. 12). Comb of 15–20 apically fringed slender teeth not inserted on a plate. Siphon with large acus just below a sclerotized plate bearing 2 simple hairs (more dorsal hair sometimes double); siphon pale brown, about 4 times diameter at base; pecten of about 20 apically fringed teeth, last 2 or 3 larger, more widely spaced, last 1 or 2 not apically fringed; pecten extending two-thirds of tube length, ending at insertion of tuft which is 6-7 branched. Hairs of anal segment as shown in Fig. 11; anal segment not ringed by plate which has conspicuous apical spines; fan plate with 10 hairs; gills sharply pointed, equal, longer than anal segment.

Type.—Male, Chizuka, Okinawa, September 1945, collected on damp rocks above a stream (R. Bohart and R. Ingram).

Paratypes.—Twenty males and 19 females (same data as type) and 15 larvae on slides (same locality and date as type) siphoned from a deep hole of narrow diameter in the rocky



FIGS. 1–8.—*Anopheles saperoi:* 1, wing; 2, scutum; 3, dorsal view of egg; 4, lateral view of egg; 5, right prothoracic submedian hairs; 6, dorsal view of larval head; 7, enlargement of leaflets from palmate hair on fifth abdominal segment; 8, pecten. FIGS. 9–10.—*Uranotaenia stonei:* 9, dorsal view of larval head; 10, male genitalia: mesosome and associated structures, margin of ninth tergite, and dististyle.



FIGS. 11, 12.—*Uranotaenia stonei:* 11, larval siphon and anal segment, including enlargements of a comb tooth, pecten teeth, and apical margin of saddle; 12, lateral spine and hair of third abdominal segment. FIG. 13.—*Aedes riversi*, ninth male tergite. FIG. 14.—*Aedes downsi*, ninth male tergite. FIGS. 15, 16.—*Aedes riversi:* 15, lateral view of apex of basal lobe of basistyle; 16, ventral view of basal lobe of basistyle. FIGS. 17, 18.—*Aedes downsi:* 17, ventral view of basal lobe of basistyle; 18, dorsal view of basal lobe of basistyle. FIG. 19.—*Aedes riversi*, outer lateral view of hind leg. FIG. 20.—*Aedes downsi*, outer lateral view of hind leg. FIG. 21.—*Aedes riversi*, larval comb. FIG. 22.—*Aedes downsi*, larval comb. FIG. 23.—*Aedes riversi*, second abdominal tergite of larva. FIG. 24.—*Aedes downsi*, second abdominal tergite of larva.

clay bank above a stream (R. Bohart). Other adult specimens were collected on damp rocks near Hedo at the northern tip of the island.

Remarks.—The only species which appear to be related to *stonei* are the Philippine *tubanguii* Baisas and the two Malayan species *ascidiicola* de Meijere and *xanthomelaena* Edwards. All these are inconspicuously marked brownish mosquitoes, the larvae of which have fine head hairs. *U. stonei*, however, has only a few pale scutal scales behind the head, distinctive pleural integumental spots and has the vertex light brown. The larva has the clypeal hairs placed farther forward than in *tubanguii* and the siphon is much longer than in *ascidiicola* or *xanthomelaena*, both of which breed in pitcher plants. The larva of *stonei* is distinctive also in the spatulate preclypeal spines, slender antenna, stout setae on the abdomen and toothed margin of the anal saddle.

We are naming this species for Dr. Alan Stone, to whom we are indebted for countless favors in connection with our studies on mosquitoes.

Aedes (Stegomyia) riversi, n. sp.

Male.—Length 3.3 mm; length of wing 3.0 mm. Head and thorax marked as in most others of the "*scutellaris* group." Proboscis with a ventral longitudinal line of pale scales. Scutum with a median silvery line, weak posterior sublateral lines and a line over wing base. Pleural markings largely linear. Abdominal tergite I with a lateral silvery patch; II–VI with lateral, oblique subbasal spots which are continued across dorsum on IV–VI as subbasal bands; III with a median basal spot; VII with a dorsolateral subbasal spot; VIII largely white. Dorsal bands on IV–VI reduced or absent in some paratypes. Underside of fore- and midfemora with a line of white scales, narrower on former; hind femur with basal half broadly white beneath, knee spot present, outer surface marked as in figure 19; tibiae dark; fore and mid tarsi with a small basal outer white patch on first two segments; hind tarsus with complete basal white bands occupying one-fifth of first segment, one-fourth of second segment, three-eighths of third segment, three-fourths of fourth segment and all of fifth segment. Genitalia (Figs. 13, 15, 16) with slender dististyle, ninth tergite strongly convex apically; and basal lobe of basistyle bearing about 8 slender setae along its dorsal edge and assorted lengths of bristles (structure best seen when lobe is dissected and mounted laterally).

Female.—Markings as in male except that abdominal tergites I–VII usually have lateral subbasal silvery patches, usually those on VI narrowly and those on VII broadly joined at middle of tergites.

Larva.—Similar to that of *Aedes albopictus*, differing chiefly in details of comb teeth (Fig. 21). Of 26 paratypes examined, all have the fringe extending at least half the length of apical barb of most comb teeth; 24 have some compound comb teeth (usually these are double, rarely triple or quadruple), average number of comb teeth 11 (range 8–14), average number of compound teeth 4 (range 0–9); average number of pecten teeth 11 (range 7–16). Submedian hairs of abdominal tergites with 3 to 5 relatively short branches (Fig. 23). Anal gills subequal and often very long, 14 paratypes having gills much longer than siphon.

Type.—Male, Chizuka, Okinawa, September 1945, reared from a rockhole along a stream (R. Bohart and R. Ingram).

Paratypes.—Twelve males, 20 females, Chizuka, Okinawa, August and September (R. Bohart and R. Ingram); 4 males, 8 females, Hentona, Okinawa, September (C. L. Harnage); 1 male, 6 females, Shana Wan, Okinawa, September (R. Bohart and R. Ingram). Paratypes were reared from rockholes, treeholes, and cut bamboos, as well as taken while biting or while resting on damp vegetation. Also, 24 paratype larvae on slides from Shana Wan, Chizuka, and Hentona, were taken from rockholes, treeholes, bamboos, and a bucket in the woods.

Remarks.—This mosquito is a frequent and annoying biter in the woods. In the key to adults of this group by Stone and Farner (Proc. Biol. Soc. Washington **58**: 159. 1945) it runs to *quasiscutellaris* Farner and R. Bohart and *horrescens* Edwards. The basal lobe of the male genitalia in the three species is similar in type, but the strong setae in *riversi* are arranged along the dorsoapical edge and they are surpassed in length by many of the bristles. The larvae of *riversi* are unusual in having multiple comb teeth as a general rule, a character previously known only in *marshallensis* Stone and R. Bohart from the Marshall Islands and the Gilbert Islands. The latter species

differs decidedly from *riversi*, however, in the reduced white markings of the legs. *Aedes riversi* represents the most northerly extension of the range of the "*scutellaris*" group which heretofore has been known only as far north as Saipan, Marianas Islands.

The species is named for Commodore T. M. Rivers, MC(S), U.S.N.R., whose interest has greatly furthered research on mosquitoes in the Pacific area.

Aedes (Stegomyia) downsi, n. sp.

Male.—Length 3.0 mm; length of wing 2.5 mm. Very similar to *Aedes albopictus*, with white banded palpus, white scaled torus, a silvery median stripe on vertex and scutum, silvery scutellum, silvery pleural patches, and basal spots on first 2 tarsal segments of fore and mid legs. Differing from *albopictus* in details of markings of scutum, hind legs and abdomen. Scutum without a spot of silvery broad scales above wing base but with a few yellowish curved scales at this point, posterior scutal lines duller and less sharply defined. Hind femur with basal half mostly white on inner surface, outer surface mostly white on basal three-fifths, the white area not drawn out into a line apically (Fig. 20); a small knee spot present; hind tarsus with basal bands occupying one-fifth of first segment, one fourth of second segment, one-half of third segment, five-sixths of fourth segment (about three-fifths in *albopictus*), and fifth segment all white (a few dark apical scales in some specimens) (Fig. 20). Abdominal tergites I–VII with basal lateral (ventral) silvery spots, tergite I with a few dorsal apical pale scales (sometimes absent), II dark dorsally, III–VI with weak basal silvery bands which do not widen laterally into spots (some paratypes with several or all tergites dark as seen from above), VIII with a broad basal band. Genitalia with dististyle slender as in *albopictus;* apical margin of ninth tergite sharply serrate (Fig. 14), basal lobe of basistyle with bristles and leaflets all of about the same lengths (Figs. 17, 18).

Female.—About as in male. Palpus broadly white-tipped, abdominal tergites with basal bands on II–V, a broad basal spot at middle of VI and a small basal spot on VII. Some specimens all dark dorsally or with incomplete bands.

Larva.—Similar to that of *albopictus*, differing in certain details. Description based on 18 paratypes taken from taro, bamboo and treeholes: Antennal tuft usually at or slightly beyond middle of shaft (usually at apical two-fifths in *albopictus*); bristles of thorax and abdomen usually stouter and with more branches (Fig. 24); comb teeth very strong, average number 9 (range 6–12), fringe rarely extending beyond basal one-fourth of barb; hair just ventral to comb averaging 6 branches (range 4–7) (usually 3 or 4 in *albopictus*); pecten teeth; usually more slender with fewer basal teeth, averaging 9 teeth (range 6–12) (about 13 in *albopictus*); siphon tuft nearly always 4-branched (2 or 3 branches in *albopictus*); saddle hair reaching to or beyond apex of longer anal gill (not reaching beyond three-fourths in *albopictus*); gills unequal and broadly rounded at apex, longer pair shorter than siphon, shorter pair usually about half as long as siphon.

Type.—Male, Chizuka, Okinawa, September 1945, reared from taro leaf axil (R. Bohart and R. Ingram).

Paratypes.—Ten males, 8 females, Chizuka, Okinawa; 7 males, 14 females, Shana Wan, Okinawa; 1 male, Hentona, Okinawa; 2 males, Hedo, Okinawa; all paratypes collected by R. Bohart and R. Ingram and taken biting or reared from taro, treeholes and cut bamboos (one paratype from Hedo reared from banana axil). Also, 16 paratype larvae on slides collected at Shana Wan and Hedo from taro, treeholes, and bamboo.

Remarks.—*Aedes downsi* differs from *albopictus* by the markings of the scutum, hind femur, fourth hind tarsal segment and abdomen. It is probably most closely related to *flavopictus* Yamada from northern Japan and Korea which according to Yamada's figure of the male genitalia (Annotationes Zoologicae Japanenses **10**: 53. 1921) has an irregular margin of the ninth tergite and stout setae on the basal lobe of the basistyle. This species differs from *flavopictus*, however, in having no spot at the end of the scutal suture, in the more angular and sharply serrate male ninth tergite and the stouter setae of the basal lobe of the male dististyle. Yamada's original description does not mention the markings of the legs and abdomen of *flavopictus* except to indicate that

they resemble those of *albopictus*. It should be noted that Barraud's figures of *flavopictus* (Fauna of British India 5 (Culicidae): 236. 1934) do not coincide with those of Yamada.

The species is named for Maj. W. G. Downs, MC, AUS, acting island epidemiologist on Okinawa, in appreciation of his contribution of specimens and other services.

ENTOMOLOGY.—*The genera of beetles of the family Bruchidae in America north of Mexico.*[1] J. C. BRIDWELL. (Communicated by W. L. SCHMITT.)

The first species of Bruchidae from our area was described in the printed inaugural dissertation, or graduation thesis, of Michael A. Baeckner presented to the faculty of Upsala under the presidency of Linnaeus and defended on December 18, 1752. In this dissertation, *Noxa insectorum*, the pea Bruchus and the oriental species now known as *Callosobruchus chinensis* were described in the new genus *Bruchus*, there used for the first time as a generic name in zoology. They are the first species of Bruchidae described.

Names prior to 1758 are not available, and it is our great misfortune that, in his tenth edition, Linnaeus did not adopt the name *Bruchus* as he later did but treated the pea weevil in his genus *Dermestes*, and that his citation of the name *Bruchus americae septentrionalis* as published by Peter Kalm, 1756, has been ruled as offering no availability of the name *Bruchus*. In Opinion 5 of the International Commission of Zoological Nomenclature names prior to 1758 which are cited in synonymy in 1758 or later are not thereby made available for use. The writer hopes that an arbitrary ruling by the Commission may make an exception in this particular case so as to avoid the great confusion resulting from long use of the homonym *Mylabris* Fabricius, 1775, for the very large group of blister beetles and the relatively recent readoption of *Mylabris* Geoffroy, 1762, for the seed weevils. Such a ruling offers the only solution to the problems arising from the same generic name having been extensively used for more than a thousand species nearly equally applied to small weevils and to large blister beetles, but the problems are even more involved. Unless *Bruchus* can be validated as of 1758, this same name as applied by Geoffroy, 1762, is to be adopted for the genus we have known under the subsequent name *Ptinus*. This would increase the number of specific names involved by more than 300. The substitution of *Mylabris* for *Bruchus* and of *Bruchus* for *Ptinus*, as proposed about 75 years ago to conform with the law of priority, has not become effective. The above suggestion to invoke the plenary power to suspend the rules and arbitrarily validate *Bruchus* Linnaeus as of 1758 appears to be the only solution. Its effect would be to maintain *Bruchus* and *Ptinus* as they have long been commonly used and to eliminate *Mylabris* from use even for the meloid genus. The older entomologists knew and disregarded the basis of this confusion.

To the pea Bruchus, which we now know to have been introduced into America, other members of the family have since been added so that now nearly 90 species of described bruchids are known to be native to our area or have become established in it by the operations of commerce. Besides these named species about half as many unnamed species have been recognized in collections by L. J. Bottimer or myself. Before undertaking to describe the novelties it has seemed desirable for the writer to distinguish the groups which he has come to recognize during more than 25 years' study of Bruchidae. The present paper is intended to make known the groups of Bruchidae in America, north of Mexico, whether native or introduced, which he believes should be considered genera.

The most recent revision of the Bruchidae of the entire world was published by Schoenherr in 1839, and there has been but little advance in the broader classification of these insects since that time. The arrangement of the species found in the United States and Canada as listed in the Leng Catalogue is based upon the revision of our species by Horn 1873 but *Mylabris*

[1] Received December 11, 1945.

Geoffroy is substituted for *Bruchus* Linnaeus. Twenty-nine valid and available generic names with their genotypes were arranged in five subfamilies by the writer in 1932 (Proc. Ent. Soc. Washington **34:** 100–106). Two additional generic names, *Sulcobruchus* Chujo, 1937, and *Specularius* Bridwell, 1938, have since become available, but these 31 genera are inadequate for the various forms now known in this family. Ten of these named genera occur in our area.

Two of the five subfamilies recognized by the writer in 1932 consist of single genera. The Eubaptinae consist of a single South American species. The Kytorhininae include only the genus *Kytorhinus*. The Pachymerinae were treated by the writer in 1929 (Proc. Ent. Soc. Washington **31:** 141–160) and the genera of Amblycerinae are herein distinguished.

The fifth subfamily, Bruchinae, includes more genera and species than all the others together, but the genera are not easily arranged into groups. *Bruchus* in the Old World and *Megacerus* in America are so different from the other genera as to warrant the erection for them of the monobasic tribes Bruchini and Megacerini. The Old World genera, of which *Bruchidius* is the center, seem to be of common descent separately from the American genera centering in *Acanthoscelides*. It seems advisable to assemble *Bruchidius* Schilsky, *Bruchinus* Schilsky, *Callosobruchus* Pic, *Specularius* Bridwell, 1938 (genotype, *Specularius erythrinae* Bridwell, 1938 = *Bruchus impressithorax* Pic, 1932), and *Sulcobruchus* Chujo into a tribe Bruchidiini. *Caryedes* Hummel, *Impressobruchus* Pic, *Pygiopachymerus* Pic, *Falsobruchus* Pic, *Gibbobruchus* Pic, *Phelomerus* Pic, *Cosmobruchus* Bridwell, *Dahlibruchus* Bridwell, and *Rhipibruchus* Bridwell may be included with *Acanthoscelides* in a tribe Acanthoscelidini. It is premature to attempt a diagnosis of Bruchidini or Acanthoscelidini. Both tribes have the prothorax conical or sometimes campanulate. An impressed line parallel to the lateral margin of the pronotum, such as is found in the Pachymerinae, is more often found in the Acanthoscelidini. In the latter the hind femur usually bears an armature of teeth and denticles, and the hind tibia is armed at apex with a mucro and a lateral apical tooth with two to five subdorsal apical denticles. Aedeagal distinctions between these two tribes also exist. Accepting for the present a tribe Acanthoscelidini for the American Bruchinae, with conical pronotum, we find two series extremely unlike if extremes be taken, but the intergradent forms cannot be very easily separated. The key here given is designed to establish new genera and to distinguish all the genera native to or accidentally established in America north of Mexico. All of them are believed to be natural groups.

KEY TO THE GENERA OF BRUCHIDAE IN THE UNITED STATES AND CANADA

1. Dorsum of prothorax without a surrounding impressed marginal line.....2
   Dorsum of prothorax with a surrounding impressed marginal line; hind femur ovate, much broader than the coxa, unicarinate beneath with a subapical great tooth and beyond it a crista bearing about 10 denticles (Pachymerinae)..... *Caryobruchus* Bridwell, 1929, *C. gleditsiae* (Linnaeus, 1763)
2. Hind tibia with two movable spurs or calcaria; hind coxa twice as broad as the femur (Amblycerinae).....3
   Hind tibia with fixed spines or teeth at apex or unarmed; hind coxa not twice as broad as the femur.....4
3. Eyes very feebly emarginate, elytra elongate, tenth stria reaching nearly to apex; prosternal process separating the coxae to apex; calcaria unequal, the longer more than half as long as first tarsal joint..... .....*Amblycerus* Thunberg, 1815
   Eyes strongly emarginate, elytra subquadrate; tenth stria abbreviate, only half as long as elytron; front coxae not separated by the prosternal process; calcaria shorter, subequal.....*Zabrotes* Horn, 1885
4. Only the pygidium fully sclerotized and exposed behind the elytra; mesepimeron strongly narrowed basally not reaching the coxal cavity (Bruchinae).....5
   Pygidium and preceding tergite fully sclerotized and exposed behind the elytra; mesepimeron not strongly narrowed basally reaching the coxal cavity; antennae serrate in female, flabellate in male (Kytorhininae); Alaska, Alberta. *Kytorhinus* Fischer von Waldheim, 1809, *K. prolixus* (Fall, 1926).
5. Prothorax without a median tooth on lateral margin, front carinate or with a glabrous line or area; male without specialized spine, teeth or lamella at apex of middle tibia..6

Prothorax emarginate on the lateral margin with a single tooth near middle before the emargination; front without a carina or glabrous line; male with specialized spines or processes at apex of middle tibia; hind femur with outer lower margin more prominent armed near apex with a strong acute tooth. . . . . *Bruchus* Linnaeus, 1767 (1758?) (Schilsky restr.)

6. Tenth stria of elytron not abbreviated; antennae never flabellate. 7
   Tenth stria not extending beyond the epipleural lobe; front carinate; antennae serrate in females, flabellate in males; pronotum conical with sides straight or concave, flanks separated from dorsum by a carina and impressed line; elytra depressed along the suture, the intervals of varying width, striae 4 and 5 abbreviated at apex, hind femur but little incrassate, ventral margin flattened with both edges carinate, inner carina simple or with a small obtuse subapical tooth or crenate or serrulate for its entire length; pygidium flat, elongate, vertical (Megacerini). . . . . *Megacerus* Fahraeus, 1839
7. Hind femur not dentate on both inner and outer edges beneath near apex, if emarginate and subdentate on outer edge then dorsum and flank of prothorax separated by a distinct arcuate lateral carina (Acanthoscelidini and *Sparteus*, Bruchidiini). . 8
   Hind femur with outer and inner edges armed near apex beneath with a single strong tooth continued toward base by longitudinal carinae; pronotum conical with convex sides, lateral carina obsolete; pygidium vertical or subvertical; antennae unlike in the sexes, subserrate in females, somewhat longer in males, or strongly serrate, or subpectinate. (Bruchidiini). . . . . *Callosobruchus* Pic, 1902
8. Antennae not extraordinarily long. 9
   Antennae of male longer than the body, reaching beyond the hind coxa in female; striae 2–4 arising from a bituberculate elevation at base of elytra; hind femur not as broad as coxa, armed beneath near apex with three similar denticles; hind tibia armed with a long slender mucro half as long as the tibia; pygidium elongate, oblique in female, more convex and vertical in male; hind femur not reaching apex of abdomen in female, extending beyond it in male. . . . *Stylantheus*, n. gen.; genotype *S. macrocerus* (Horn) (*Bruchus macrocerus* Horn, 1873)
9. Hind femur with a strong tooth or spine near apex, beneath, within, and beyond this one or more denticles. 10
   Hind femur unarmed or with a single tooth or spine without denticles. 15
10. Hind femur strongly incrassate, broader than its coxa, channeled beneath, outer edge of ventral margin crenate or serrulate; pygidium of female with a rounded mirror-like area. . . . . *Gibbobruchus* Pic, 1913, *G. mimus* (Say, 1831)
    Hind femur with the outer ventral margin not crenate or serrulate. 11
11. Fourth stria of elytron abbreviate at base starting from a small tubercle; hind femur with inner edge beneath serrulate with a strong tooth beyond the serrulations and after a space with about four denticles. . *Meibomeus* n. gen.; genotype *M. musculus* (Say) (*Bruchus musculus* Say, 1831)
    Fourth stria not abbreviate at base; femoral denticles approximate to the tooth. 12
12. Hind femur broader than the coxa, subsulcate beneath armed beneath within near apex with a strong tooth and 3 or 4 denticles; scutellum transverse; some of the striae arising from basal dentiform elevations; last sternite emarginate in both sexes. . . . *Merobruchus*, n. gen.; genotype *M. julianus* (Horn) (*Bruchus julianus* Horn, 1894)
    Hind femur not broader than coxa, only 1 or 2 denticles, or if more than 2 denticles the elytron without basal dentiform elevations 13
13. Abdomen elongate, the femur not reaching apex of abdomen; pygidium subhorizontal, elongate, bent down at apex in male; elytra with basal dentiform elevations. . 14
    Abdomen less elongate, oblique or subvertical . . . . . *Acanthoscelides* Schilsky, 1905
14. Scutellum transverse; mucro short; front with glabrous area expanded toward vertex; hind femur profoundly channeled beneath in male. . *Mimosestes*, n. gen.; genotype *M. sallaei* (Sharp) (*Bruchus sallaei* Sharp, 1885)
    Scutellum twice as long as broad; mucro elongate, frontal glabrous line not expanded toward vertex; hind femur alike in the sexes not profoundly channeled beneath. . *Algarobius*, n. gen.; genotype *A. prosopis* (LeConte)[2] (*Bruchus prosopis* LeConte, 1858)
15. Sides of pronotum convex, surface of dorsum even; depth of body less than width. . . . 16
    Sides of pronotum concave, dorsum uneven; front strongly carinate; depth of body about as great as width; elytral striae 5 and 6 abbreviated at apex; pygidium elongate, convex, oblique. . *Neltumius*, n. gen.; genotype *N. arizonensis* (Schaeffer) (*Bruchus arizonensis* Schaeffer, 1904)
16. Pronotum with flanks separated from dorsum by a lateral carina ending near coxal cavity. 17

[2] This species includes also *Bruchus uniformis* and *desertorum* LeConte 1858.

Pronotum with flanks not separated by a carina, the lateral carina vestigial or wanting.....18

17. Lateral carina of pronotum simple, in an even curve, not denticulate; pygidium unlike in the sexes; hind femur alike in the sexes, flattened beneath, both edges carinate, the outer more prominent, emarginate before the apical lamella, the inner with a strong suberect tooth near apex; front with a glabrous line not expanded above, or subcarinate; antennae alike in the sexes, not serrate; hind tibia with mucro much longer than lateral apical tooth..... *Stator*, n. gen.; genotype *S. pruininus* (Horn) (*Bruchus pruininus* Horn, 1873)

Lateral carina abruptly bent downward to the coxa with a few denticulations before the middle; pygidium alike in the sexes; hind femur with inner edge carinate, emarginate near apex and produced into a broad flat tooth before the emargination, with a deep pubescent sulcus at base in male; front with a glabrous area expanded above to vertex; antennae serrate, larger in male; hind tibia with lateral apical tooth longer than the mucro..*Cercidiestes*, n. gen.; genotype *C. ulkei* (Horn) (*Bruchus ulkei* Horn, 1873)

18. Hind femur beneath near apex with a distinct tooth or spine.....19

Hind femur unarmed beneath or at most with a minute denticle.....20

19. Hind femur beneath not at all carinate on either margin, inner margin with a strong obliquely truncate spine often tridenticulate on the truncation..*Althaeus*, n. gen.; genotype *A. hibisci* (Olivier) (*Bruchus hibisci* Olivier, 1795)

Hind femur beneath with inner margin carinate, the carina extending nearly to base, microserrulate before the simple spine *Sennius*, n. gen.; genotype *S. cruentatus* (Horn) (*Bruchus cruentatus* Horn, 1873)

20. Elytra with striae 4 and 5 abbreviate at apex; inner margin of hind femur beneath carinate with an apical emargination and a minute denticle or angulation before it... *Sparteus*, n. gen.; genotype *S. villosus* (Fabricius) (*Bruchus villosus* Fabricius, 1792)

Elytra with striae 5 and 6 abbreviate at apex, hind femora entirely without carinae or denticles beneath..*Abutiloneus idoneus*, n. gen. and new sp. (*Bruchus flavicornis* Schaeffer, 1907, and perhaps Sharp, 1885; not *Bruchus flavicornis* Fabricius, 1792)

Abutiloneus idoneus is a small species 1.6 to 1.8 mm long by 1.0 to 1.1 mm wide, densely clothed with pale yellowish to silvery pubescence almost concealing the black integument, the antennae and legs uniformly clear lemon-yellow. Several lots of specimens with the following data have been examined: San Diego, Tex., E. A. Schwarz, May 4–7, probably 1879, 9 specimens; Corpus Christi, Tex., F. C. Pratt, April 12, 1906, one specimen; Brownsville, Tex., L. J. Bottimer, one specimen extracted from a seed of *Abutilon berlandieri* collected by H. C. Hanson, probably in 1919; Brownsville, Tex., reared by the writer in 1921 from Abutilon, 37 specimens: Guerrero, Coahuila, L. J. Bottimer, December 30, 1924, to February 15, 1925, reared from seeds to *Abutilon berlandieri*, collected December 9, 1924, 19 specimens; Brownsville, Tex., Bibby and Higdon, December 12, 1939, from *Abutilon berlandieri*, 6 specimens; Brownsville, Tex., I. Shiller, April 1941, with seeds of *Abutilon lignosum*, 33 specimens; Reynosa, Mexico, through A. J. Chapman, April 3–11, 1941, *Abutilon lignosum*, 12 specimens.

Type locality.—Brownsville, Tex.

Type and 97 paratypes.—U.S.N.M. no. 57766. Twenty paratypes in collection of L. J. Bottimer.

Excluded Genera

North American Bruchidae have been placed in 19 genera; 10 of these genonyms are believed not applicable to any of our species, for reasons indicated with each name.

(1) *Curculio* Linnaeus, 1758, genotype *B. nucum* Linnaeus, designated by Latreille, 1810. Type genus of Curculionidae.

(2) *Dermestes* Linnaeus, 1758, genotype *D. lardarius* Linnaeus, designated by Latreille, 1810. Type genus of Dermestidae.

(3) *Mylabris* Geoffroy, 1762, genotype *Bruchus pisi* Linnaeus, 1767, designated by Bridwell, 1932. I have considered this a synonym of *Bruchus* Linnaeus, 1758. See introductory discussion of *Bruchus*.

(4) *Laria* Scopoli, 1763, genotype *Laria dulcamarae* Scopoli, designated by Bridwell, 1932, accepted by Barber, 1942 (U. S. Dept. Agr. Misc. Bull. 468, p. 9) (*Pria* Stephens, 1829, genotype *Pria truncatella* Marsham, 1802, monobasic. Isogenotypic with *Laria* by synonomy, *Laria dulcamarae* = *Pria truncatella*). This species also appears to be the unnamed type

upon which *Byturus* Latreille, 1796, was erected, but not one of the forms to which the name is now attached. Hence *Laria* is a genus of Nitidulidae.

(5) *Pachymerus* Thunberg, 1805, genotype *Pachymerus bactris* = *Dermestes bactris* Linnaeus, 1763, monobasic.

(6) *Caryoborus* Schoenherr, 1833, genotype *Bruchus* (*Caryoborus*) *serripes* = *Bruchus serripes* Sturm, 1826, by original designation. This and the preceding are distinct tropical American genera without species in our area. *Dermestes gleditsiae* Linnaeus, 1763 = *Bruchus arthriticus* Fabricius, 1801, referred to *Caryoborus* by Schoenherr, 1833 and to *Pachymerus* by Pic, 1913, is the genotype of *Caryobruchus* Bridwell, 1929. *Caryedon fuscus*, of which *Caryoborus gonagra* (Fabricius) is a synonym, is a polyphagous species widely distributed in the Old World tropics. In West Africa a species of *Caryedon* is reported under other names as seriously injurious to the peanut (*Arachis hypogaea*) but is in all probability this species. *Caryedon fuscus* has in late years become established in Jamaica, Hispaniola, and Dutch Guiana and may be expected to become established in the United States.

(7) *Pseudopachymerus* Pic, 1913, genotype *Pseudopachymerus brasiliensis* (Thunberg) = *Bruchus brasiliensis* Thunberg, 1816. Failing to trace *Pachymerus* to its source and to find its true genotype, Schoenherr, 1833, designated *Bruchus brasiliensis* Thunberg, 1816, as genotype of *Pachymerus*. This species is congeneric with *Bruchus faldermanni* Mannerheim, 1827, genotype of *Caryedes* Hummel, 1827, a tropical American genus without species in our area. *Pedapholus* Gistl, 1848, Naturg. Thierreichs X (new synonymy), *Adromisus* De Gozis, 1881, and *Pseudopachymerus* Pic, 1913, substitute names for *Pachymerus* Schoenherr not Thunberg having *Bruchus brasiliensis* Thunberg for genotype are synonyms of *Caryedes*. *Bruchus* (*Pachymerus*) *crataegi* Fahraeus, 1839, is a synonym of *Bruchus mimus* Say, which has now been referred to *Gibbobruchus* Pic, 1913. Sharp, 1885, Schilsky, 1905, and others have extended Schoenherr's misapplication of *Pachymerus* to include some species of *Callosobruchus* Pic. These have only a slight resemblance in body form of Schoenherr's pseudotype and have only family characters in common with the true *Pachymerus* as typified by *bactris*.

(8) *Spermophagus* Schoenherr, 1833, genotype *Spermophagus titivilitius* Boheman, 1833, by original designation. The species originally included in *Spermophagus* are referable to three well defined genera; *Amblycerus* Thunberg, 1815, *Spermophagus* restricted, and *Zabrotes* Horn, 1885. Zacher, 1930, divided the genus into three genera, *Spermophagus*, *Zabrotes*, and *Euspermophagus*, the last proposed as new. The group to which he misapplied the name *Spermophagus* is *Amblycerus*, genotype *Bruchus robiniae* Fabricius, 1781. The type of *Spermophagus*, *S. titivilitius*, is, from the description, not congeneric with *robiniae* but with the genotype of *Euspermophagus*, which must therefore be suppressed as a synonym of *Spermophagus* if my conclusions are correct. *Spermophagus titivilitius* was described as from Mexico but the available evidence leads me to believe this an error and that the species is native to the Old World. The same conclusion has been reached for *S. rufiventris* Boheman described at the same time from the Crimea and from Brazil and compared with *titivilitius*. Both species were described as having the abdomen red which is common in *Spermophagus* while in *Zabrotes* the abdomen is always black. Hence *Spermophagus* appears to be the proper name for all Old World Amblycerinae excepting, perhaps, *Pygospermophagus brevicornis* Pic, 1917. This name is based upon a single male which may be a *Spermophagus* with exaggerated secondary sexual characters; the female, when discovered, may be a normal *Spermophagus*. *Spermophagus* has not been described sufficiently to distinguish it from *Zabrotes* which it resembles in its short, compact form, with the pygidium and last visible sternite unlike in the sexes and with the lateral carina of the pronotum complete; in both genera the eyes are deeply emarginate, the ventral surface of the hind tibia is

flattened and definitely limited outwardly by a carina or a row of bristles; the scutellum is a small simple triangle; the short elytra barely cover the base of the pygidium; the calcaria of the hind tibia are short and subequal. From *Zabrotes*, *Spermophagus* differs in these four ways:

A. The tenth elytral stria is complete reaching both base and apex while in *Zabrotes* this stria is abbreviate at apex, not extending beyond the middle of the elytron.

B. In *Spermophagus* the flanks of the pronotum below the lateral carina are produced anteriorly into a vertical carina which hides the hind margin of the eye in repose; this structure is not present in *Zabrotes*.

C. In *Spermophagus* the intercoxal process of the prosternum, when seen from in front, is acuminate reaching nearly or quite to the apex of the coxa and has a vertical posterior face between the coxae reaching from their apices to the connecting membrane; this process in *Zabrotes*, when seen from in front, is a short triangle separating the coxae for only half of their length without a posterior vertical face.

D. The outer apical lamella of the hind femur is elevated, its apical angle rounded in *Spermophagus* while in *Zabrotes* this angle is acute. The great majority of species of *Spermophagus* are attached to species of Convolvulaceae, a few to Malvaceae (*Hibiscus* and *Urena*), host plants not known to be affected by *Amblycerus* or *Zabrotes*. One African species affects a species of Cassia. Species of *Spermophagus* are found in England, in Sweden and eastward to Japan, south to New Caledonia, Australia, (*Bruchus perpastus* Lea, 1899, from Western Australia being a species of *Spermophagus*) and the Cape of Good Hope, but are in complete confusion, so that application of names is impossible without study of types. No species referable to *Spermophagus* as here restricted has been seen from any American locality.

(9) *Bruchidius* Schilsky, 1905, as originally described is too polymorphic to remain undivided. *Bruchidius quinqueguttatus* (Olivier, 1795) is the designated genotype, Bridwell, 1932. No American bruchid seems congeneric with this species. *Bruchus villosus* Fabricius, 1792, has become established in Massachusetts and in Virginia. It was included by Shilsky in *Bruchidius* under the untenable name *Bruchidius cisti* (Paykull) and is the genotype of a new genus, *Sparteus*, above described.

(10) *Pachybruchus* Pic, 1912. The genotype, *Bruchus coryphae* Olivier, 1795, designated by Bridwell, 1932, is congeneric with the genotype of *Megacerus* Fahraeus, 1833.

ZOOLOGY.—*A new sea anemone from Woods Hole, Massachusetts.*[1]

SEARS CROWELL, Miami University, Oxford, Ohio, and Marine Biological Laboratory, Woods Hole, Mass. (Communicated by WALDO L. SCHMITT.)

In 1939, Dr. William J. Bowen brought to me specimens of a small sea anemone taken from the Mill Pond, at Woods Hole. This anemone is noteworthy in several respects: (1) It belongs to a genus hitherto represented by only one species, and that from only one locality, the Isle of Wight in the English Channel. (2) It has evaded observation until recently, even though it is abundant at a location almost in the shadow of the Marine Biological Laboratory. (3) It possesses nematosomes. These are small clusters of cells that bear nematocysts and that move around freely in the coelenteron without permanent attachment to the body of the anemone. These nematosomes are being studied further, since no knowledge of their function or origin exists. (4) It is well suited for study by students in general or invertebrate zoology, in that it is small, transparent, simple in structure, hardy, and available at almost all seasons. It has been used by the classes at the Marine Biological Laboratory and successfully shipped as far as Ohio, where it arrived in good condition.

[1] Received December 20, 1945.

Genus **Nematostella** Stephenson, 1935

The genus *Nematostella* was established by Stephenson to include those Edwardsidae that could not be referred to *Edwardsia* because of the absence of nemathybomes and that could not be referred to *Milne-Edwardsia* because the outer tentacles are longer than the inner. From both of these genera it differs in the possession of nematosomes. The type species is *Nematostella vectensis* Stephenson, 1935.

Nematostella pellucida, n. sp.

Diagnosis.—With the characters of the genus. Length of body in extension up to 20 mm. Width at physa one-sixth the length, tapering to one-tenth the length below the tentacles. Body transparent and entirely lacking in external markings. The transparency makes the insertions of the eight primary mesenteries very evident. Each, as seen through the body wall, appears as a double line, tan or dark brown. The throat is a lighter tan. The lips are conspicuous, being almost white or yellowish. Scapulus not distinct from scapus. Physa well developed but not sharply marked off from scapus. Physa smooth in extension, wrinkled when contracted.

Tentacles 16, rarely less, in two cycles of eight each. In normal expansion the tentacles of a specimen 10 mm long have a length of 4–5 mm in the outer, exocoelic cycle, a length of 3–4 mm in the inner, endocoelic cycle. In extreme expansion the tentacles may slightly exceed the length of the body. Each tentacle bears four or five whitish marks on its inner face, and these are equally spaced along the length of the tentacle. These spots consist of groups of tiny spherical granules in the gastrodermis (endoderm). They appear white by reflected light and dark in transmitted light. (See Fig. 6.) The relationship of the tentacles to the mesenteries is shown by Fig. 2.

There are eight primary mesenteries (macrocnemes). The dorsal and ventral pairs are directive. The muscles of the four lateral mesenteries face toward the ventral directives as shown by the semicircles in Fig. 2. There are no other mesenteries except for eight minute microcnemes. These are restricted to the bases of those adjacent tentacles not separated by primary mesenteries. They do not connect with the body wall itself, since their length is only that of the diameter of a tentacle. Their width is about one-half their length and in a specimen 10 mm long did not exceed 35 microns. Fig. 2 shows their position and width. Fig. 7 is intended to illustrate their insignificance more accurately. The retractor muscles of the primary mesenteries are simple or slightly branched as shown in Fig. 3. The parietal muscles appear as little tufts.

Eggs have been found in specimens less than 10 mm long. These are developed in the usual position on all primary mesenteries, below the throat, between the retractors and mesenterial filaments. While being anesthetized prior to preservation the type specimen discharged 10 eggs and about 100 nematosomes. These were all held together loosely by a mucous substance. The diameter of the eggs is 175 microns. I have no other information concerning the reproduction or life history.

When viewed with a dissecting microscope the nematosomes can be clearly seen through the body wall. A few are usually moving about in the coelenteron. Most of them are at the insertions of the mesenteries in the body wall. Thus there are 16 rows, one on each side of the eight insertions. Within the rows the nematosomes are irregularly spaced. They are easily dislodged but soon return to positions of loose attachment along the mesenterial insertions. Their number is variable. For a specimen 10 mm long there are about 20 on each side of each insertion, or 300 to 400 altogether. Each nematosome consists of 20 to 30 nematocysts, radially arranged, and of flagellated cells responsible for their locomotion. They are nearly spherical with a diameter of 27–30 microns. These bodies, the nematosomes, were first described by Stephenson (1935) and are known only in *Nematostella* and in *Milne-Edwardsia polaris* (Stephenson, 1935, pp. 48, 408).

The types and sizes of the nematocysts are:

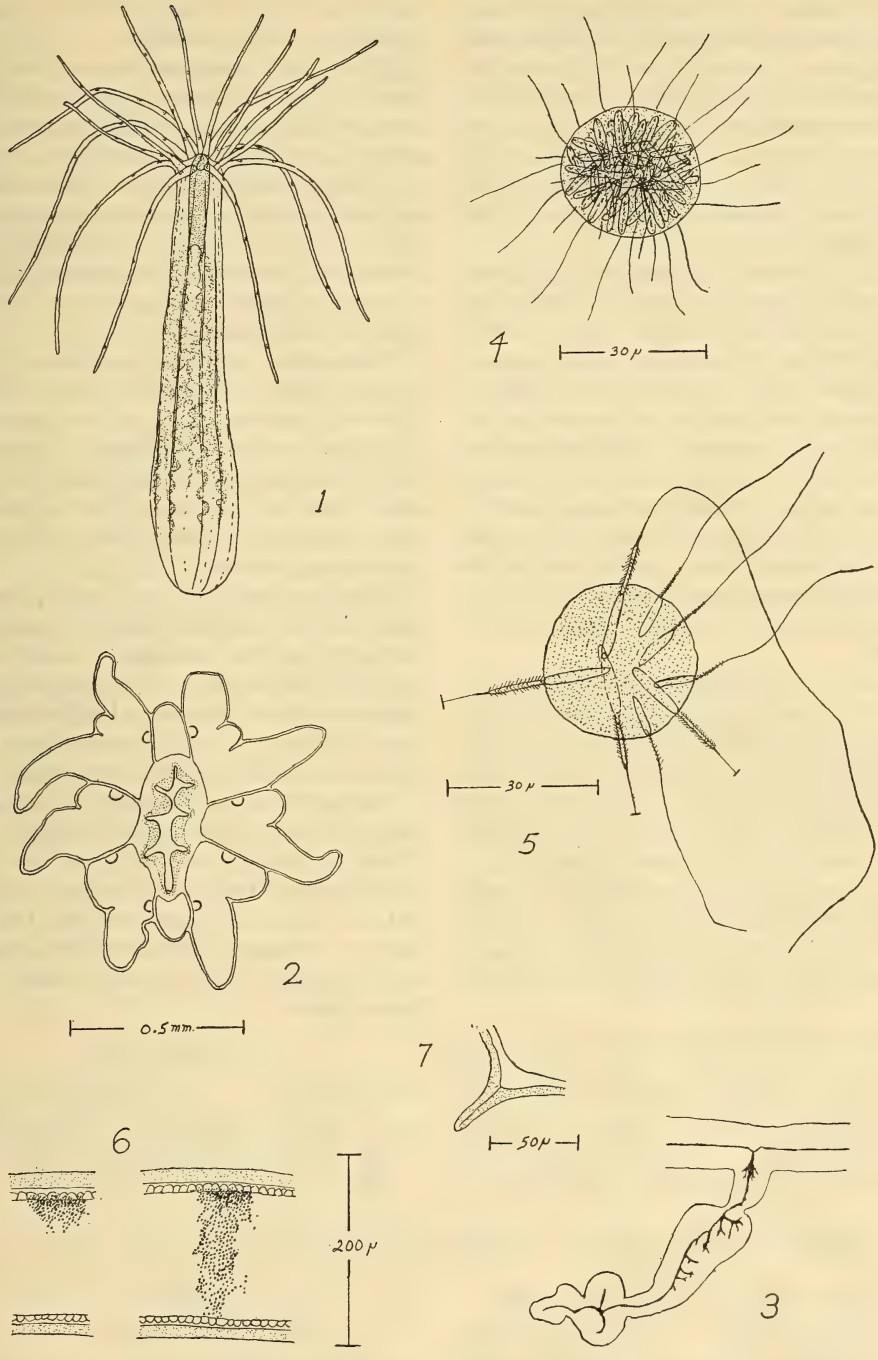
Tentacles. (1) Spirulae (Stephenson) or basitrichous isorhizas (Weill): Capsule 13 to 22μ, typically 18$\times$2.5μ; tube spiny for 18μ; tube length 110μ. (2) Spirocysts: Capsule average length 20μ.

Upper Column. Spirulae or basitrichous isorhizas: Capsule 9.5 to 11.0$\mu\times$2.2 to 2.8μ, average 10$\times$2.5μ; tube spiny for 11μ, tube length 30 to 60μ.

Physa. Spirulae or basitrichous isorhizas: Capsule average 9.4$\times$2.5μ.

Throat. (1) Basitrichous isorhizas: Capsule 18μ; tube spiny for 18μ, tube length 60 to 85μ. (2) Microbasic mastigophores: Capsule 20$\times$ 4.5μ; butt (hampe) 24 to 29μ; total tube length 85μ.

Mesenterial Filaments. (1) Basitrichous isorhizas: Capsule 18μ; tube spiny for 16 to 18μ, total tube length 35 to 55μ. (2) Microbasic mastigophores: Capsule 18 to 23$\mu\times$4.5 to 5.5μ; butt 22μ; total tube length 70μ.



FIGS. 1–7.—*Nematostella pellucida*, n. sp.: 1, Specimen with body length of 10 mm; 2, diagram of an actual section through bases of tentacles, showing relationships of mesenteries and tentacles, location of retractor muscles at a lower level indicated by semicircles; 3, pattern of a retractor muscle just below throat; 4, nematosome with nematocysts undischarged (its flagella shown); 5, nematosome after discharge of some of its nematocysts (diagrammatic), only a few of nematocysts shown (long tubes of 3 of microbasic mastigophores cut off, as indicated by a line ⊥ to tube; smaller nematocysts are basitrichous isorhizas); 6, diagrams showing appearance of granules of tentacle spots with transmitted light, at left tentacle shown in side view, at right it is viewed from its inner face (epidermis stippled); 7, junction of 2 tentacle bases showing a microcneme at its maximum width (gastrodermis stippled).

NEMATOSOMES. (1) Basitrichous isorhizas: Capsule 13μ; tube 40 to 60μ. (2) Microbasic mastigophores: Capsule 17$\times$4.5μ; butt 13μ, tube 100μ. The first of these types is about three times more abundant than the more conspicuous latter type. (See Figs. 4 and 5.)

Type.—U.S.N.M. no. 43763; paratypes in U. S. National Museum and in author's collection, Oxford, Ohio.

Locality.—Known only from the Mill Pond, Woods Hole, Mass. This pond is 300 to 400 feet in diameter. The water is nowhere over 2 feet deep, but there is another foot or more of unconsolidated muck. An 18-inch tile, 200 feet long, connects the pond to sea water (in the Eel Pond), and through this tile the tide enters and leaves. In the only test made the water had 94 per cent of the chlorine content of water in the harbor. After heavy rains the salt content is doubtless lower. Marine forms such as the blue crab (*Callinectes sapidus*) and the anemone *Sagartia luciae* also are found in the Mill Pond.

Taxonomic relationships.—It is possible to describe the present form as a variety or race of *Nematostella vectensis*. An attempt to make direct comparisons of specimens was unsuccessful because of the war. Both *N. vectensis* and *N. pellucida* occur in shallow brackish pools or ponds. I have treated *N. pellucida* as a distinct species partly because of the great distance between the known localities, and the impossibility of there being suitable intermediate brackish pools across or around the Atlantic Ocean.

The anatomical distinctions are in the pattern of coloration on the body, and in the tentacle spots. Although coloration in anemones is highly variable, pattern is fairly constant. Stephenson describes an elaborate, definite, and constant pattern at the bases of the tentacles of *vectensis*. No hint of any such markings occurs in *pellucida*.

N. pellucida possesses four or five definite spots on the inner face of each tentacle but in *vectensis* the markings of the tentacles are described as irregular and dispersed.

I believe this American *Nematostella, N. pellucida*, should be regarded as a species distinct from the British *N. vectensis*. Should future study produce intermediate forms, and a change of status seem necessary, this can be done without confusion.

Observations on living specimens.—In the normal habitat *N. pellucida* rests upright in mud with tentacles, disc, and scapulus exposed above the surface. It secretes a mucous substance adequate to hold the walls of its burrow away from the epidermis. This is not a real tube, however, and does not persist after the anemone is removed.

When removed from mud and placed in a glass dish *Nematostella* exhibits peristalsis-like contractions. The circular muscles contract below the tentacles and the place of contraction moves slowly the whole length of the specimen. A second wave of contraction starts as the first reaches the end of the physa.

The anemone can tolerate a considerable dilution of the salt content of water in which it lives. Specimens remained active and in good condition after ten days exposure to 1 part sea water to 2 parts of distilled water. The British form, *N. vectensis*, is subject to wide variations in the salinity of the pools where it lives (Stephenson).

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WEILL, R. *Contribution a l'étude des cnidaires et de leurs nematocystes.* Trav. Stat. Zool. Wimereux **10** and **11**: 1–702. 1934.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

NEW MEMBERS OF THE ACADEMY

There follows a list of persons recently elected to membership in the Academy, by vote of its Board of Managers, who have since qualified as members in accordance with the by-laws of the Academy. The bases for election are stated with the names of the new members.

RESIDENT

Elected February 12, 1945

JOHN WILLIAM MITCHELL, physiologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md., in recognition of his contributions to plant physiology, in particular his researches on plant hormones and growth-regulating substances.

Elected June 18, 1945

SEARS POLYDORE DOOLITTLE, plant pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md., in recognition of his pioneer work on virus diseases of vegetables, especially of mosaic disease of Cucurbitaceae, including insect-vector relationships, seed transmission of virus, and breeding of disease-resistant vegetables.

EARLE HESSE KENNARD, physicist, David Taylor Model Basin, Washington, D. C., in recognition of his services to the science of physics, and in particular the development of theoretical analyses of underwater explosion phenomena.

MARTIN ALEXANDER MASON, engineer, Beach Erosion Board, Washington, D. C., in recognition of his work in the field of hydraulics, particularly researches on oscillatory waves in water and related shore processes.

DOUGLAS EUGENE PARSONS, engineer, National Bureau of Standards, Washington, D. C., in recognition of his investigations of the factors affecting the structural properties of reinforced concrete members and the strength, elastic properties, water permeability, and durability of masonry; also, his successful efforts to increase the reliability and to lower the cost of reinforced concrete and masonry structures.

FREDERICK WILLIAM POOS, JR., entomologist, Bureau of Entomology and Plant Quarantine, Beltsville, Md., in recognition of his contributions to a knowledge of the bionomics and control of several insects affecting cereal, forage, and truck crops, more especially insect vectors of plant diseases and insects causing disease-like injuries to plants.

FRANK WALTER REINHART, chemist, National Bureau of Standards, Washington, D. C., in recognition of his achievements in research on the properties of organic plastics, the film characteristics of cellulose derivatives used in airplane dopes and lacquers and the development of improved methods of evaluating the physical and chemical properties of plastics.

GALEN BRANDT SCHUBAUER, physicist, National Bureau of Standards, Washington, D. C., in recognition of his work on boundary-layer flow phenomena and wind-tunnel turbulence.

ARNOLD M. SOOKNE, chemist, Milton Harris Associates, Washington, D. C., in recognition of his contributions to the physical chemistry of high polymers, particularly fibers.

FRANK EDWARD TODD, entomologist, Bureau of Entomology and Plant Quarantine, Beltsville, Md., in recognition of his researches, reports, and publications in the field of bee culture, more particularly on the role of pollen in the life of the hive; the trapping of pollen; composition and properties of pollens; and the value of honey bees in the pollination of crops.

DWIGHT F. WINDENBURG, engineer, David Taylor Model Basin, Washington, D. C., in recognition of his contributions to the design of ship structures and in particular the strength of vessels under external pressure such as the hulls of submarines and unfired pressure vessels.

WILLIAM JOHN ZAUMEYER, plant pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md., in recognition of the excellent quality of his researches on the diseases of beans and peas.

NONRESIDENT

Elected June 18, 1945

GUSTAV EGLOFF, chemist, Universal Oil Products Co., Chicago, Ill., in recognition of his contributions to petroleum chemistry, particularly in connection with cracking processes and with the reactions and properties of hydrocarbons.

F. G. BRICKWEDDE, *Secretary*

CHEMICAL SOCIETY

567TH MEETING

The 567th meeting (61st annual meeting) was held at the Cosmos Club on January 11, 1945. The reports of officers for 1944 were read and accepted. The membership of committees for 1945 was announced. Dr. EDGAR REYNOLDS SMITH, of the National Bureau of Standards, spoke on *Electrolytic transport of water in relation to the hydration of ions.*

568TH MEETING

The 568th meeting was held at the Cosmos Club on February 8, 1945. Dr. ROBERT B. WOODWARD, of Harvard University, spoke on *The total synthesis of quinine.*

569TH MEETING

The 569th meeting was held at the Cosmos Club on February 22, 1945. DR. ROBERT

SIMHA, of Howard University, spoke on *Viscosity, sedimentation, diffusion and molecular weight and shape of high polymers.*

570TH MEETING

The 570th meeting and annual dinner of the Society was held at the Roger Smith Hotel on March 8, 1945. The Hillebrand Prize for 1944 was awarded to Dr. RAYMOND M. HANN, National Institute of Health, in recognition of his work on the chemistry, synthesis, and structure of the methylene and benzylidene acetals of sugar alcohols. Dr. CLIFFORD B. PURVES, of McGill University, spoke on *Cyclic acetals of carbohydrates*, to be published in this JOURNAL.

571ST MEETING

The 571st meeting was held at the Cosmos Club on April 5, 1945. Dr. E. G. ROCHOW, of General Electric Co., spoke on *Organosilicon polymers.*

572D MEETING

The 572d meeting was held at the Cosmos Club on April 12, 1945. Dr. W. F. JACKSON, of the Explosives Department of E. I. du Pont de Nemours and Co., spoke on *General properties of gun propellants.*

573D MEETING

The 573d meeting was held at the University of Maryland on May 10, 1945. At the general meeting the Borden Award for research in the chemistry of milk for 1945 was presented to Dr. BEN H. NICOLET, of the Bureau of Dairy Industry. At the conclusion of the general meeting, the following divisional meetings were held:

Biochemistry, J. R. SPIES, *presiding*

Studies on the sex attractant of the female gypsy moth. H. L. HALLER and FRED ACREE, JR. (Bureau of Entomology and Plant Quarantine).

The metabolism of DDT. HERBERT O. CALVERY, GEOFFREY OFNER, and RUTH OFNER (Food and Drug Administration).

On the mechanism of the enzymatic oxidation of catechols. HOWARD S. MASON (National Institute of Health).

Inorganic and Analytical Chemistry, A. GABRIEL, *presiding*

A rapid fluorescent method for determination of Beryllium in ores. MARY H. FLETCHER, CHARLES E. WHITE, and MILTON S. SHEFTEL (Bureau of Mines).

Spectrophotometric determination of titanium in steels. ALFRED WEISSLER (Naval Research Laboratory).

Standardization of acid with KIO_3. PETER OESPER (University of Maryland).

Anion exchange in soils. L. A. DEAN and E. J. RUBINS (Bureau of Plant Industry, Soils, and Agricultural Engineering).

Organic Chemistry, JOHN K. WOLFE, *presiding*

DDT: A new synthetic organic insecticide. H. L. HALLER (Bureau of Entomology and Plant Quarantine).

A method for the measurement of gel strength and data on starch fractions. W. J. HAMER (National Bureau of Standards).

Cis-trans isomers of 3-(alpha-naphthyl)-1-propene. T. H. HARRIS and C. M. MACKALL (George Washington University).

The oxidation of melezitose with periodate. N. K. RICHTMYER and C S. HUDSON (National Institute of Health).

Physical Chemistry, W. J. SVIRBELY, *presiding*

Dipole moments of diethyl sulphite, triethyl phosphate, tetraethyl silicate and carbowax 4000. J. J. LANDER and W. J. SVIRBELY (University of Maryland).

Methods of calculating the properties of hydrocarbons and its application to the refractive indices, densities, and boiling points of the paraffin and monoolefin hydrocarbons. W. J. TAYLOR, JOAN M. PIGNOCCO, and F. D. ROSSINI (National Bureau of Standards).

Heats and free energies of formation of the paraffin hydrocarbons in the gaseous state at 1500° K. E. J. PROSEN, K. S. PITZER, and F. D. ROSSINI (National Bureau of Standards).

The freezing temperature of benzoic acid as a fixed point in precision thermometry. F. W. SCHWAB and E. WICHERS (National Bureau of Standards).

574TH MEETING

The 574th meeting was held at Georgetown University on October 11, 1945. At the conclusion of a general meeting, the following divisional meetings were held:

Biochemistry, M. X. SULLIVAN, *presiding*

The cystine and methionine content of various proteins and diets. W. C. HESS (Chemo-Medical Research Institute, Georgetown University).

Chemical methods for the assay of penicillin M. MUNDELL and D. C. GROVE (Food and Drug Administration).

Desaminases for nucleic acids. J. P. GREENSTEIN and A. H. CHALKLEY (National Cancer Institute).

Tests for various biogenous amines. M. X. SULLIVAN (Chemo-Medical Research Institute, Georgetown University).

Inorganic and Analytical Chemistry, R. GILCHRIST, *presiding*

Separation of radioactive arsenic from copper and germanium. A. T. NESS (National Institute of Health).

Method for the determination of small amounts of gold and its use in ascertaining the thickness of electrodeposited gold plate. W. S. CLABAUGH (National Bureau of Standards).

A new method for the determination of phenolic fungicides. S. GOTTLIEB and P. B. MARSH (Bureau of Plant Industry, Soils, and Agricultural Engineering).

Spectrophotometric determination of tyrosine and tryptophane. H. R. MULLIN (National Bureau of Standards).

Organic Chemistry, H. L. HALLER, *presiding*

A study of the dehydrochlorination of some DDT analogues and of the benzene hexachlorides. S. J. CRISTOL (Bureau of Entomology and Plant Quarantine).

Oxidation of hydroquinone in the presence of pyridine. H. W. BAERNSTEIN (National Institute of Health).

New antimalarials. E. L. MAY (National Institute of Health).

The determination of estrone in blood. F. P. VEITCH (Georgetown University School of Medicine).

Physical Chemistry, H. S. MASON, *presiding*

The use of radioactive sodium in the measurement of flow of large volumes of water. D. B. COWIE (Carnegie Institution of Washington).

The application of the ultracentrifuge and associated instruments to particle analysis. H. KAHLER (National Cancer Institute).

Spectrographic methods applied to photoperiodic response of plants. S. B. HENDRICKS and M. W. PARKER (Bureau of Plant Industry, Soils, and Agricultural Engineering).

575TH MEETING

The 575th meeting was held at the Cosmos Club on November 8, 1945. Dr. BEN H. NICOLET, Bureau of Dairy Industry, spoke on *Some aspects of the chemistry of phospho-proteins.* The election of officers for 1946 was held with the following results: President, L. A. SHINN; Secretary, I. C. SCHOONOVER; Treasurer, J. J. FAHEY; Councilors, N. BEKKEDAHL, W. C. CAGLE, N. L. DRAKE, W. L. HALL, H. L. HALLER, S. B. HENDRICKS, H. S. ISBELL, B. H. NICOLET, E. J. PROSEN, E. R. SMITH, M. X. SULLIVAN, W. J. SVIRBELY, J. K. WOLFE; Managers, R. GILCHRIST, B. J. MAIR, A. T. MCPHERSON, R. A. OSBORN, H. A. RUTHERFORD, J. L. SVIRBELY.

576TH MEETING

The 576th meeting was held at George Washington University on December 13, 1945. Dr. JAMES F. COUCH, Chief of the Tobacco Section of the Eastern Regional Research Laboratory, spoke on *Rutin and the vitamin P effect.*

LEO A. SHINN, *Secretary*

Obituary

SOFIE AMALIA NORDHOFF-JUNG, distinguished physician, died in Washington, D. C., on June 6, 1943, after a long illness. She was born in Bielefeld, Westphalia, Germany, on April 25, 1867. She received her early education at the parochial school at Bielefeld until her fourteenth year, when, following the Nordhoff tradition, she continued her studies at Sacred Heart Convent, Toul, France, until 1884. Shortly afterward the family came to America, where Dr. Jung accepted a position as teacher of French and German at Georgetown Convent, Washington, D. C.

Father Murphy, chaplain, suggested that she take up the study of medicine, which she did at Columbian College, now George Washington University, receiving her degree in 1893. She then went to France and continued her studies at the Pasteur Institute in Paris under Louis Pasteur as one of the few American pupils

of the great scientist. Later she went to Munich to perfect herself in the special field she had chosen, was made clinical instructor in obstetrics at the University Hospital in Munich, and later resident physician at the Frauenklinik.

She met Dr. Franz A. R. Jung on her return trip to America, and they were married shortly afterward. They established their offices at 1229 Connecticut Avenue in Washington, building the house according to special plans suitable for offices and residence, and here they engaged in private practice from 1897 to 1923.

In 1914 she and her husband took their usual summer trip to Europe, she having accepted an invitation to work in Prof. Gustav Klein's clinic to study his methods of treating uterine cancer, in which she had become greatly interested while working with him the previous summer. She and her husband had hardly arrived in Munich when the war broke out, and they with hundreds of other Americans were stranded.

Red Cross work was started and a call for volunteers was sent out, to which she and her husband promptly responded. On request, lectures on First Aid were given by her to hundreds of Americans. These lectures were such as she had been giving in Washington under the auspices of the Red Cross for 20 years. Through the efforts of Ambassador James W. Gerard, a Red Cross Hospital was organized, and on September 23 the Stars and Strips were hoisted over the building at No. 9 Prinz-Ludwig-Strasse. It was called the American Model Hospital and was a success from the very beginning. Ambassador Gerard was president of its board and mentions its work in his book, *My four years in Germany*. During the two and a half years of the existence of the hospital the Jungs remained in charge, giving all their time and energy gratuitously, leaving it only to sleep and eat in a nearby family hotel. When diplomatic relations were severed, the hospital was closed on February 26, 1917. During this period of uninterrupted overwork and lack of nourishing food, the health of both of them gradually gave way completely. Forced by the revolutions to remain on in Munich, and without funds, they were unable to return to the United States until December 31, 1919. As a result of overwork and undernourishment, Dr. Franz Jung died in Washington in January 1923.

On March 10, 1927, the German Government awarded Dr. Sofie A. Nordhoff-Jung the official Cross of Honor of the German Red Cross in recognition of the distinguished services she had rendered during the war in Germany. The medal was presented by Baron Maltzan, the German Ambassador, with an accompanying diploma and note of congratulation.

In 1923 Dr. Nordhoff-Jung became instructor of gynecology at Georgetown University Hospital. In 1932 she was made associate professor in gynecology, and in 1939 she became professor emeritus of gynecology.

For many years she had been interested in cancer research, and she established a prize for scientific research in this field. Father Nevils, of Georgetown University, on page 207 of his *Miniatures*, says: "In her great zeal for scientific advance in cancer research Doctor Jung has set aside a fund whereby every second year a cash prize of one thousand dollars with a beautifully inscribed citation is awarded the scientist who, according to the selection of a special committee, has done outstanding work in cancer research." In 1927 the prize was given to Dr. Otto Warburg, director of the Department of Biology of the Kaiser Wilhelm Institute, Berlin-Dahlem. In 1930 it was awarded to Dr. Alexis Carrel, of New York.

As a memorial to her husband, who was a distinguished gastroenterologist, Dr. Jung donated the fourth floor of the Nurses' Home at the Georgetown University Hospital, where a plaque commemorates this gift. For a number of years she was a benefactress of the Georgetown University Hospital, and upon her death she left a legacy of approximately $200,000 in trust to it.

Dr. Jung was a member of the Anthropological Society of Washington for about 15 years, of the Medical Society of the District of Columbia for about 46 years, and of the Washington Academy of Sciences for about 44 years.

ANNA BARTSCH DUNNE.

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JOURNAL
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VOLUME 36 MARCH 15, 1946 No. 3

CHEMISTRY.—*Cyclic acetals of the carbohydrates.*[1] C. B. PURVES, Division of Industrial and Cellulose Chemistry, McGill University, Montreal. (Communicated by JAMES I. HOFFMAN.)

In deciding upon a suitable topic on which to address the Chemical Society of Washington on this occasion, I could not help remembering my inconclusive efforts, as a student of Sir James Irvine, to determine the structure of benzylidene methylglucoside. The contrast between what we knew then about cyclic acetals of the carbohydrates and what we know today is a very sharp one. It seemed to me that it might be worth while to review in brief outline some of the history of these cyclic acetals and to summarize the great progress made in that field during the past few years.

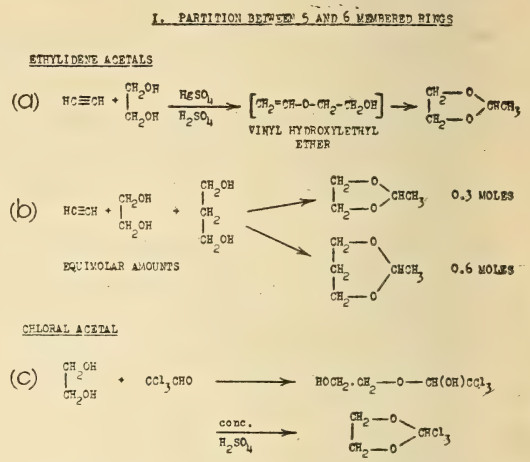
Ethylene oxide has long been known to add to ethylene glycol and to yield a polyethylene glycol, and acetaldehyde has long been known to possess the same molecular formula as ethylene oxide. If ethylene oxide combined with glycol, what might acetaldehyde and glycol do? This line of thought led Wurtz in 1861 (*1*) to heat those two substances together on the steam-bath for eight days, and, to his surprise, he found that the product was not one of simple addition but had involved the removal of the elements of water from the starting materials. Wurtz had synthesized the first cyclic acetal, ethylidene glycol. In the next year Guenther (*2*) showed that the synthesis proceeded much more readily when mineral acids such as hydrochloric or sulphuric were present, and at a later date acidic salts like zinc chloride and calcium chloride, or nearly neutral salts like copper sulphate, were shown to be effective (*3*). Several of the cyclic acetals derived from acetaldehyde, benzaldehyde, and acetone, and involving the simple glycols like glycerol and ethylene and propylene glycol, were synthesized in the following years. Then in the 1880's and 1890's sugar chemists, including Tollens and Emil Fischer, produced many of the acetals of the sugars, the glycosides and the sugar alcohols. For the most part these acetals were beautiful crystalline compounds, stable, as Wurtz had shown, to alkalis but readily hydrolyzed by acids. These properties made them very useful in the separation and identification of sugar alcohols and similar substances. Moreover, the fact that some of the alcohol groups in the parent acetals were blocked by the acetal rings made it possible to prepare pure partly substituted carbohydrates by esterifying or otherwise modifying these hydroxyl groups and later, by limited hydrolysis, removing the acetal constituent. But such budding synthetical methods were thwarted because in general there was no way of determining either the constitution of the product or the position and the ring structure of the cyclic acetal groups in the parent substance. It was plain that the ring structure must be 5-membered in some cases, as it obviously was in Wurtz's ethylidene ethylene glycol. In other cases the structure was obviously 6-membered, as in cyclic acetals derived from trimethylene glycol. Emil Fischer (*4*) seems to have kept an open mind on the size of the rings in such condensation products, but, unfortunately, he assumed a 5-membered ring for the glycosides of the sugars. Since the glycosides are cyclic acetals of a mixed type, the analogy prejudiced the average worker in favor of 5-membered

[1] An address delivered at the 570th meeting of the Chemical Society of Washington, March 8, 1945, on the occasion of the granting of the Hillebrand Award for 1944 to Dr. R. M. Hann. Received January 24, 1946.

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rings in all cases where there was no positive evidence to the contrary. As late as 1926 Professor Haworth (*5*) was able to say, "It seems to be the accepted rule that acetone, like boric acid, condenses with *cis* hydroxyl groups of adjacent carbon atoms." Although that opinion is probably true with few exceptions today,[2] up to 1926 it was frequently and erroneously extended to acetals derived from other carbonyl compounds. The error, of course, was a natural one and received support from Baeyer's strain theory, enunciated in 1885, that 5-membered rings were most likely to be formed because the formation involved the least deflection of the tetrahedral valencies of carbon from their normal positions in space (*7*). The decade commencing in 1923 saw the tacit assumption of 5-membered structures in cyclic acetals overthrown for the sugars themselves by the work of Hirst and Haworth in Britain, and for the simpler cyclic acetals by that of Hibbert at Yale and later at McGill University. In both cases it became apparent that 5- and 6-membered ring structures usually formed with ease and sometimes existed together in a state of dynamic equilibrium. It will be well to pause for a moment to consider some of the late Professor Hibbert's publications, since they repeat and greatly extend much earlier work and since he was particularly interested in studying the relative ease of formation of the 5- and 6-membered types.

In some of his early researches Professor Hibbert preferred to prepare ethylidene acetals, not in the usual manner by the use of acetaldehyde and an acid catalyst, but by passing acetylene into the glycol in presence of a little sulphuric acid and mercuric sulphate (*8*). This method of acetal formation originated in Germany (*9*) and was used by the late Father Nieuwland (*10*). The formulas Ia indicate that the open-chain vinyl hydroxyethyl ether was the intermediate when acetylene was condensed with ethylene glycol. This evidence was supported by the observation that vinyl hydroxyethyl ether, when prepared by other methods, rearranged with almost explosive



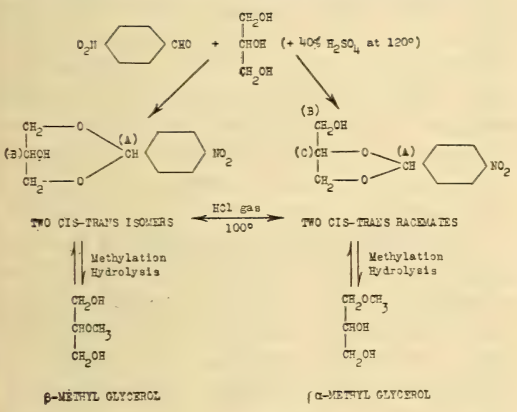
violence into the cyclic acetal when brought into contact with a trace of strong acid (*11*). Professor Hibbert's plan of research depended upon the Michael Partition Principle, in which two competitive courses are created for the same reaction and the relative amounts of the two products are determined. In the present case (Ib), equimolecular amounts of acetylene, ethylene glycol and trimethylene glycol were allowed to react in the presence of the catalyst and the yield of the trimethylene acetal was found to be approximately twice that of the ethylene acetal (*12*). In other words, the 6-membered ring, rather than the 5-membered ring, was formed in greater amount and presumably was formed more readily since the system was homogeneous. The same result was obtained in similar experiments with other equimolecular mixtures of an α-glycol and a β-glycol.

The acetylene method of investigating ease of ring formation was obviously restricted to the ethylidene series, but Hibbert succeeded in generalizing the results by condensing other carbonyl compounds with glycols in the presence of an acid catalyst. Such condensations probably proceeded through an intermediate open-chain hemiacetal such as that shown for chloral and ethylene glycol (Ic). This particular hemiacetal was actually isolated in the crystal-

[2] But note 6-membered rings in isopropylidene pentaerythritol, xylose and sorbose. Ingold and Thorpe (*6*) suggested that the two methyl groups in the isopropylidene unit spread the corresponding valencies to the central carbon atom apart, and narrowed the angle between the other two valencies forming the cyclic acetal ring. The latter therefore tended to be 5- rather than 6-membered.

line state by de Forcand in 1889 (*13*), and the general occurrence of such addition products in solution was made probable in the 1920's by Professor Adkins and his collaborators (*14*). In order to preserve the principle of the partition method, the glycol used was glycerol, since glycerol is obviously capable of forming 5- and 6-membered cyclic acetals simultaneously. The general nature of Professor Hibbert's results (*15*) is summarized by the formulas II. One mole of a carbonyl compound, in

II. ISOMERIC CYCLIC ACETALS OF GLYCEROL WITH p-NITROBENZALDEHYDE

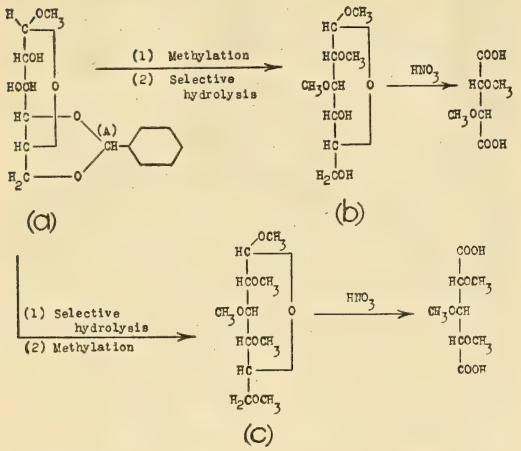


this case *p*-nitrobenzaldehyde, was condensed with one mole of glycerol, and the crude condensation product was found to consist of two pairs of isomers (*16*). The left-hand pair on methylation with silver oxide and methyl iodide, followed by hydrolysis of the acetal ring, yielded β-methyl glycerol. Similar treatment of the right-hand pair yielded α-methyl glycerol. It was therefore plain that both 5- and 6-membered rings were formed simultaneously and in approximately equal amount. As shown in the formulas, the particular example chosen was made complicated by the occurrence of *cis-trans* ring isomerism. When we consider the 6-membered acetal ring to the left, it is seen that the *p*-nitrophenyl group attached to carbon A may lie either on the same or on the opposite side of the plane of the ring as the hydroxyl group attached to atom B. We therefore have two *cis-trans* isomers. Since the ring has a plane of symmetry AB there are no asymmetric carbon atoms. The 5-membered acetal ring to the right also yields two *cis-trans* isomers in which the *p*-nitrophenyl group and the hydroxymethyl group B are on the same or on opposite sides of the ring, but each isomer is theoretically capable of optical resolution into D and L forms since the carbon atoms A and C are asymmetric. These possibilities of isomerism were first pointed out by Emil Fischer. Peacock, in 1915 (*17*), probably succeeded in effecting a partial resolution of the DL forms of the benzylidene cyclic acetal. It is obvious that if the carbonyl component is either formaldehyde or acetone, carbon A is attached either to two hydrogen atoms or to two methyl groups and the possibility of *cis-trans* isomerism vanishes. Research in the methylidene and isopropylidene series is therefore less complicated than that in other series. Before we leave formulas II, we may note that as a rule the 5-membered attained equilibrium with the 6-membered isomers in presence of acid catalysts (*18*). Van Roon discovered and Hibbert confirmed the fact that the position of the equilibrium was dependent on temperature and seemed to move in favor of the 6-membered structures as the temperature was lowered. Extensive investigations on the condensation of glycerol with formaldehyde, acetaldehyde, benzaldehyde and several similar compounds showed that in every case except two both types of cyclic acetals were formed and could be brought into equilibrium with each other (*15*). The two exceptions were chloral (*19*) and acetone (*20*) which formed 5-membered rings exclusively. The chloral acetal was also peculiar because it was exceedingly resistant toward hydrolysis with aqueous acid (*19*). Another unusual case was tetramethylene glycol, which produced a 7-membered cyclic acetal when condensed with acetylene (*8*). As a result of such studies, together with those of Haworth and Hirst, it became clear that the ring size neither of the sugar glycosides nor of the acetals could be assumed from *a priori* reasoning. The structure of each individual substance had therefore to be independently established by experimental methods. The methylation method, originated by Thomas Purdie and Sir James Irvine at St. Andrew's University, was the

only one of general validity and by its intensive use the constitutions of several of the more important acetals of the sugars and sugar glycosides were eventually determined (*21*).

We may take as an example 4,6-benzylidene methylglucoside (formula IIIa) which has two optically active *cis-trans* isomers

III. STRUCTURE OF 4,6-BENZYLIDENE METHYLGLUCOSIDE

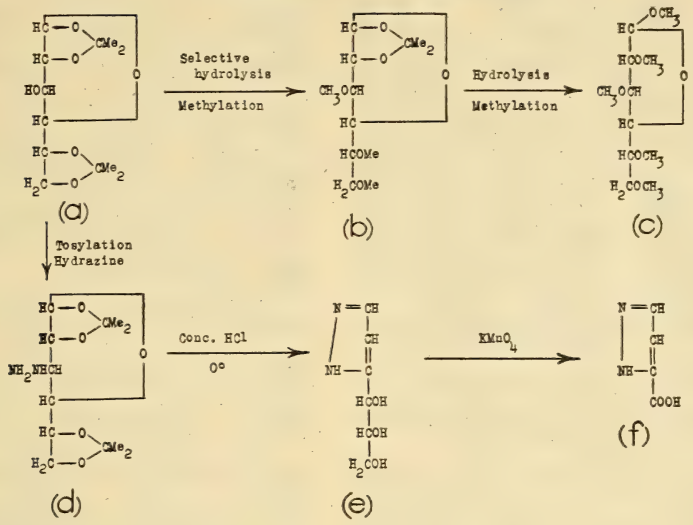


of the type described. Methylation of all the remaining hydroxyl groups in the substance, followed by selective hydrolysis of the benzylidene group by dilute acid, yielded a partly methylated methylglycoside, 2,3-dimethyl methylglucoside (IIIb). The positions of the methoxy groups in the latter were determined by oxidation with nitric acid to a standard reference substance, in this case D-dimethyltartaric acid. The next phase of the work involved first the removal of the benzylidene group by selective hydrolysis, and then complete methylation of the resulting methylglucoside (IIIc) in order to determine its ring structure. This determination depended upon an oxidation to trimethoxy-xylo-glutaric acid.

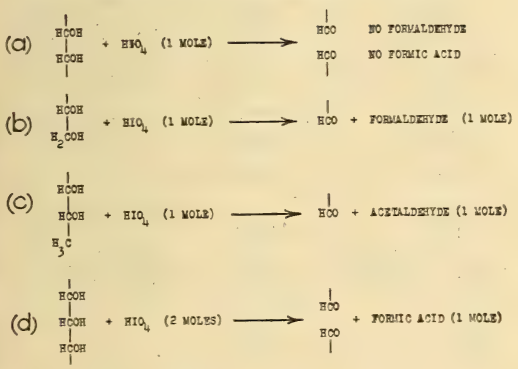
Formulas IV illustrate the application of the method to di-isopropylidene glucose (IVa). Selective hydrolysis removed one acetone group preferentially and complete methylation of the resulting mono-isopropylidene glucose "froze" the oxygen bridge linking in the sugar in its original position (IVb). It was then possible to remove the other acetone residue, complete the methylation (IVc) and use the oxidation technique to determine the ring structure of the sugar. Sometimes, of course, short-cuts were discovered and one of the more interesting is shown. Freudenberg and Doser (*22*) made the mono *p*-toluenesulphonyl ester of di-isopropylidene glucose and found that the ester group could be replaced by the hydrazine residue. This hydrazino derivative (IVd), when treated with cold concentrated hydrochloric acid, passed in nearly quantitative yield to a pyrazole derivative (IVe) which was oxidized to the well-known pyrazole-3-carboxylic acid (IVf). The free hydroxyl group in di-isopropylidene glucose was therefore attached to the third carbon atom. Since the cyclic structure of the sugar occupied the fourth position and since acetal rings are usually either 5- or 6-membered, the structures of the di- and mono-isopropylidene glucoses were as indicated. It will be seen that the methylation method just outlined was excessively laborious from a technical point of view, even although it was often supplemented by other data and was eventually supported by a series of partly methylated sugars that served as reference substances. In these circumstances, progress in determining the constitution of the cyclic acetals was slow and it is not surprising that investigators found it very much easier to prepare numerous cyclic acetals of the carbohydrates than to determine their constitutions. New experimental methods were required and it is to these, combined together and in part originated by Dr. Hann and his associates, that we must now turn.

Malaprade in 1934 discovered that aqueous solutions of periodic acid cleaved glycols containing adjacent hydroxyl groups in a highly selective manner (*23*). The cleavage was inhibited by substituents such as acetyl or benzoyl present on one or both of the hydroxyl groups of the glycol. The formulas V show the way in which various types of glycol units are oxidized by periodate. The simplest type (Va) is oxidized to two molecules of aldehyde, with the consumption of one mole of periodic acid. No formaldehyde or formic acid is formed. In the second case, where one of the glycol groups is a primary

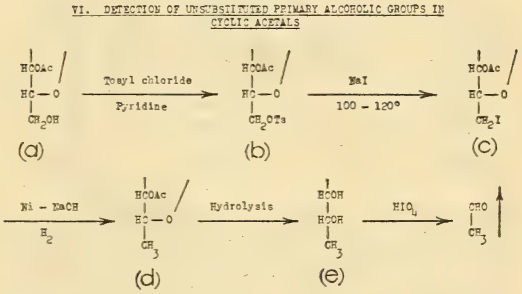
IV. STRUCTURES OF ISOPROPYLIDENE GLUCOSES



V. DETECTION OF UNSUBSTITUTED ADJACENT HYDROXYL GROUPS



VI. DETECTION OF UNSUBSTITUTED PRIMARY ALCOHOLIC GROUPS IN CYCLIC ACETALS



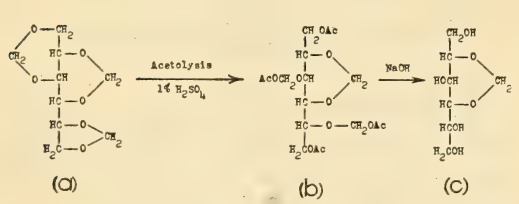
alcohol, a higher aldehyde and formaldehyde are produced (Vb). In the third case, where one end of the glycol unit is attached to a methyl group, acetaldehyde is one of the products (Vc), and in the case where three alcoholic groups are adjacent to each other, the middle group is removed from the system as formic acid and two moles of periodate are consumed (Vd). It is obvious that the occurrence of any of these four types of glycol in the molecule of a sugar acetal can be estimated and detected by knowing the amount of periodate consumed and the amount of formaldehyde, acetaldehyde, or formic acid evolved. Criegee has shown that lead tetraacetate oxidizes glycols in essentially the same way and is an alternate oxidant for periodate (*24*).

The next new method, illustrated by formulas VI, was originated in 1932 by Oldham and Rutherford (*25*). They found that primary alcoholic groups in glucose derivatives can be distinguished from secondary alcoholic groups because only the primary *p*-toluenesulphonyl esters are unstable in presence of sodium iodide in a ketonic solvent at 100°. The primary alcoholic groups (VIa) are thereby selectively changed to alkyl iodide and can be estimated quantitatively by analyzing the latter (VIc) for iodine. It has since been noted that the replacement of primary tosyl by iodine does not always proceed at the same rate (*26*), that the presence of unsubstituted alcoholic groups may promote secondary

reactions, and that adjacent tosyl groups may yield unsaturates (*27*). For these reasons it is usually desirable to reduce the iodo derivative to a methyl group (VId) and to hydrolyze the product to VIe. Oxidation with periodic acid then liberates acetaldehyde and estimation of the latter by Nicolet and Shinn's convenient procedure (*28*) checks the validity of the whole method. The third new principle, discovered some three years ago by Dr. Hann and his associates at the National Institute of Health, is that methylene acetals engaging primary alcoholic groups are cleaved by acetolysis under conditions in which methylene acetals, involving secondary alcoholic groups exclusively, are nearly stable (*29*).

The formulas VII illustrate the principle in the case of trimethylene D-sorbitol (*30*). This substance contains cyclic structures

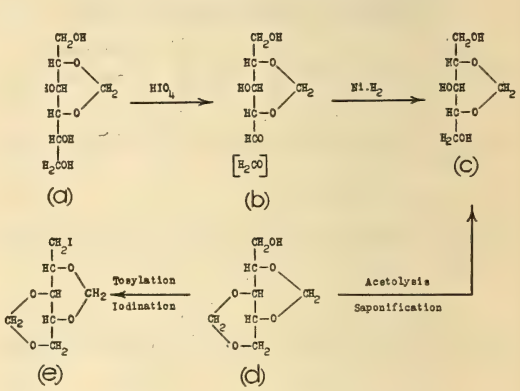
VII. SELECTIVE ACETOLYSIS OF CYCLIC METHYLENE ACETALS



engaging the primary alcohol position 1 with secondary alcohol position 3, and the primary alcohol position 6 with the secondary alcohol position 5 (VIIa). When the trimethylene sorbitol is dissolved in acetic anhydride-acetic acid solution containing 1 per cent of sulphuric acid, these two methylene acetal rings are cleaved, the cleavage presumably occurring at the primary alcohol positions because these positions now carry acetyl, and the methylene residues remain attached to the two secondary alcohol positions (VIIb). These methylene residues are now hemiacetals of formaldehyde which have become acetylated. Deacetylation therefore removes them, as well as ordinary acetyl groups, and the whole procedure replaces the two methylene cyclic structures by two primary and two secondary alcoholic groups (VIIc). It will be seen that the 2,4-methylene acetal ring in the trimethylene sorbitol survives this selective acetolysis and does not involve any primary alcoholic groups. If the possible methylene acetal structures be limited to those of 5, 6 or 7 members, that of the trimethylene D-sorbitol follows from that of the monomethylene derivative. The same research shows that 1,3:2,4-dimethylene sorbitol is produced concurrently with the trimethylene derivative. The structure of the former, proved independently, supported that assigned to the latter.

I would now like to present one typical example of the way in which these elegant new methods are used to determine the structure of the acetals (*30*). The example chosen is 2,4-methylene D-sorbitol (VIIc or VIIIa). This substance contains only one unsubstituted glycol unit and this glycol includes a primary alcoholic group. Oxidation with periodic acid will therefore remove

VIII. STRUCTURE OF SORBITOL AND XYLITOL METHYLENE ACETALS



this primary alcohol as one mole of formaldehyde; one mole of periodic acid will be consumed and one mole of a monomethylene pentose sugar will be produced (VIIIb). Reduction of the carbonyl group in the latter gives the corresponding methylene pentitol, which happens to be internally compensated and of an optically inactive, meso type (VIIIc). Since it is stable to periodic acid, it contains no hydroxyl groups adjacent to each other and the methylene acetal ring must be in the position shown, namely, 2,4. The pentitol proved to be xylitol. It is worthwhile to point out that if the cyclic structure in the original methylene D-sorbitol were in the 3,5 position, the glycol group capable of oxidation by per-

iodate would be the 1,2 instead of the 5.6 isomer. The pentose sugar formed would be the 2,4 methylene D-arabinose and reduction would yield an optically active 2,4 methylene D-arabitol, also stable to periodate.

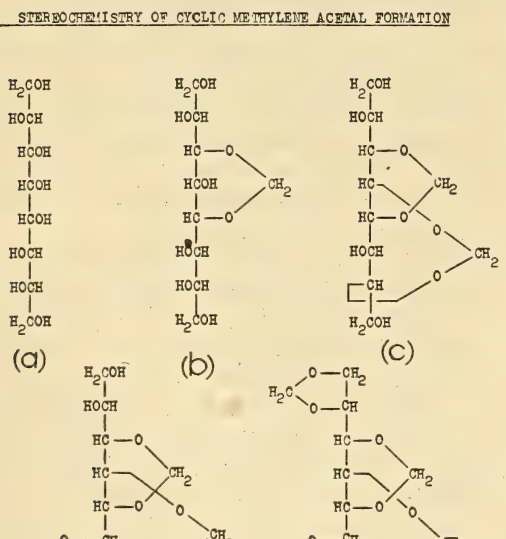
These conclusions can be checked by condensing the internally compensated, optically inactive xylitol with formaldehyde to obtain 2,4:3,5 dimethylene xylitol (VIIId). Consideration shows that the alternative structure 1,3:2,4-dimethylene xylitol would also form in equal amount and that it is the optical antipode of the structure shown. The product is therefore a racemic mixture of D and L forms. Esterification with *p*-toluenesulphonyl chloride gives an ester that is readily decomposed by sodium iodide in acetone to an iodo-derivative (VIIIe). This smooth reaction demonstrates that the remaining hydroxy group in the 2,4:3,5 dimethylene xylitol is of a primary alcoholic nature. The select ve acetolysis of this derivative, followed by saponification of the acetyl and acetoxymethyl groups in the product, gives the meso 2,4-methylene xylitol (VIIIc). The structures of all of the compounds in the sorbitol and xylitol series are therefore established by unambiguous interrelated methods. In order to illustrate the precision and power of these methods, let us assume for a moment that the ring in methylene D-sorbitol is in the 2,5 position, as it happens to be in a certain methylene mannitol (*29*). The tosylation-iodination technique would reveal the fact that the two primary alcoholic groups remain unsubstituted, but the failure to recover formaldehyde in the periodate oxidation would show that the second and fifth hydroxyl groups are substituted. The position of the methylene bridge as 2,5 would have been demonstrated at once. This conclusion would have been checked by the fact that in the 2,5 structure a glycol group remains in the 3,4 position: the periodate oxidation would therefore consume one mole of oxidant and the product on hydrolysis would produce two moles of glyceraldehyde; no formic acid and no formaldehyde being evolved.

Another reaction that has proved to be of great value is the selective esterification of primary alcoholic groups. D-sorbitol, for example, readily yields a crystalline 1,6-dibenzoate when limited amounts of benzoyl chloride are used in the benzoylation. Benzoyl groups are more stable than the ordinary cyclic acetal during acetolysis and hydrolysis. If sorbitol 1,6-dibenzoate is condensed with formaldehyde, the presence of the benzoyl groups denies the primary alcoholic positions to the entering acetal groups and the product is not a trimethylene sorbitol but a dimethylene sorbitol in which the rings occupy the 2,4 and the 3,5 positions (*31*). The latter ring is unusual because the hydroxyl groups concerned are *trans* to each other instead of being *cis* and are in the *β* position. This *trans* six-membered ring is less stable and can be selectively removed by acetolysis even although it contains no primary alcoholic groups. Whenever required, benzoyl radicals can be hydrolyzed away by alkali without disturbing acetal rings.

But there is no time to follow the work of Dr. Hann and his collaborators through all the intricacies of 5-, 6-, and 7-membered acetals of the sugar alcohols or to depict in detail the structures of acetals of mannitol (*29*, *32*), sorbitol (*26*, *30*, *31*, *33*), dulcitol (*34*, *35*, *36*), adonitol (*37*), arabitol (*38*), xylitol (*30*, *39*), fucitol (*40*), iditol (*41*), rhamnitol (*42*), and epirhamnitol (*26*, *43*) containing one, two, or three such rings, based as these rings are upon formaldehyde, benzaldehyde, *o*-nitrobenzaldehyde, or acetone. There is no need here to catalogue their acetates, benzoates, *p*-toluenesulphonates, their benzyl or acetoxymethyl ethers or their iodo derivatives. Suffice it to say that the general methods outlined above gave satisfactory results in the numerous cases studied, even when they had to cope with a very occasional wandering of a benzoyl group (*34*) or with the complexities of *cis-trans* isomerism (*36*) in the benzylidene dulcitols. When we close our eyes and imagine that one of the carbohydrate polyalcohols is mixed with a condensing agent and a carbonyl compound, we can picture rings of all sizes forming and disintegrating and competing with each other for the different pairs of alcoholic groups in the carbohydrate structure. We can picture the cyclic

structures, formed most readily, or most stable, or least soluble, slowly accumulating in the mêlée and eventually crystallizing from solution as the compounds that are actually isolated. As far as these products are concerned, Dr. Hann has very fortunately been able to point out some regularities that connect the probability of cyclic acetal formation with the nature of the pairs of alcoholic groups and their relative position in space (*44*). I have had the temerity to attempt to summarize his tentative conclusions as regards methylene and also benzylidene acetals.

IX. STEREOCHEMISTRY OF CYCLIC METHYLENE ACETAL FORMATION

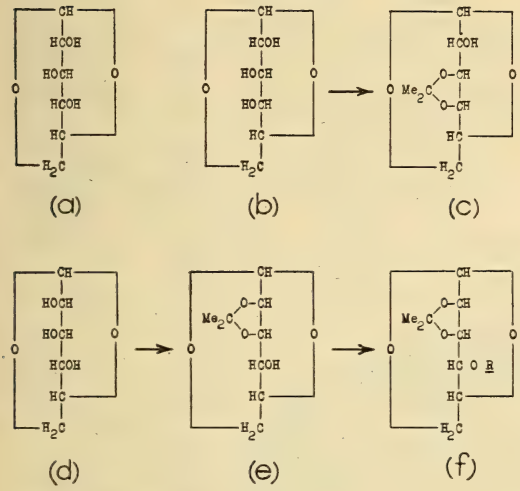


Let us suppose that the 8-carbon sugar alcohol (formula IXa) is dissolved in approximately equal amounts of concentrated hydrochloric acid and 37 per cent formalin. Of the very large number of cyclic acetals theoretically possible, it appears that the pair of alcoholic groups most suited for acetal formation are of a secondary nature and are situated in β positions, *cis* to each other. The only pair satisfying these requirements are the hydroxy groups in the third and fifth positions of the octitol and we can assume that a 6-membered 3,5-methylene acetal will survive in the equilibria.

The next most likely group to attach itself, assuming the positions 3 and 5 are no longer available, is the rather unusual 7-membered ring formed about secondary hydroxyl groups that are *trans* and *gamma* to each other. The fourth and seventh groups are such a pair and the appropriate structure is IXc. The third most available site is a 6-membered ring involving a primary alcohol. Since the latter seems to be capable of free rotation, the question of *cis-trans* orientation is not important, and we can assume that a third methylene group would attach itself between positions 6 and 8 (IXd). Finally, one of the least probable structures, that forms only if the appropriate hydroxyl groups have not already been utilized, is the 5-membered ring involving a primary alcohol (IXe). Our tetramethylene octitol might therefore be expected to have methylene groups in the 1,2:3,5:4.7:6,8 positions. Although the particular octitol was chosen merely as an illustration, it happens to be L-manno-D-altro octitol and is not, so far as I know, one of those synthesized by Dr. Hann and his friends in numerous researches in that field (*45*). This aspect of Dr. Hann's collaborations lies outside the scope of this paper. Let us consider instead the isopropylidene derivatives of some sugar anhydrides with which Dr. Hann has worked.

D-Glucosan (Xa) has been known for a long time and is prepared by the destructive distillation of glucose, starch or cellulose. It contains three hydroxyl groups all of which are *trans* to their immediate neighbors. This situation is not propitious for condensation with acetone and no isopropylidene derivatives of glucosan are known. But a mixture of glucosan and galactosan is readily available by the dry distillation of lactose and galactosan possesses a pair of adjacent *cis* hydroxyl groups (Xb). Galactosan can readily be isolated from a mixture with the glucosan as the isopropylidene derivative (*46*) and has therefore been made a cheap and easily accessible substance (Xc). In the same way the destructive distillation of ivory-nut mannan yields D-mannosan (Xd) which is readily isolated as the isopropylidene derivative (Xe) (*47*). In addition to the value of such new beautiful crystalline

X. CYCLIC ACETALS AS AIDS IN SYNTHESIS AND ISOLATION



substances as intermediates for the isolation of sugar anhydrides, they offer very great promise as intermediates in synthetic work. In each case only one hydroxyl group is left exposed for further reactions and synthetical procedures can therefore be planned to take an unambiguous course. The free position in the isopropylidene galactosan is number 2 and the way is open to prepare derivatives of galactosan and galactose substituted in the second position (*46*). Perhaps more important is the lone hydroxyl group in isopropylidene mannosan because it occupies the hitherto inaccessible fourth position in the mannose molecule. This is the position engaged by the disaccharide linkage in the more important di- and poly-saccharides such as maltose, starch, cellobiose, cellulose and lactose. Drs. Haskins, Hann, and Hudson (*48*) have not only methylated isopropylidene mannosan (Xf, R = CH_3) and completely hydrolyzed the product to the interesting and new 4-methyl mannose but have also condensed it with acetobromoglucose and acetobromogalactose (Xf, R = tetraacetyl β-gluco- and β-galacto-pyranosyl). Selective hydrolysis with acetic acid removed the isopropylidene residue from the products. Acetolysis cleaved the 1,6 anhydro ring and left an acetylated β-glucosidomannose and β-galactosidomannose, epimers of cellobiose and lactose respectively. It would take us too far afield to follow the subsequent steps leading to cellobiose and lactose themselves (*48*). The syntheses are the first to provide unambiguous and definite confirmations for the accepted structures of these two important disaccharides. Another synthesis from 4-tosyl isopropylidene mannosan (Xf, R = tosyl) led by way of a Walden inversion to what was presumably 3,4-anhydro-D-talosan (*49*).

When we come to evaluate the significance of these advances, we see that the cyclic acetals of the sugars have long been used as starting materials for the synthesis of partly substituted carbohydrate derivatives and disaccharides. But it was necessary to determine the constitution of each of these derivatives in a separate research that was usually lengthy and round-about. Today this great range of carbohydrate chemistry has been illuminated and the wheel has turned full circle. Cyclic acetals of definitely known constitution have become among the most accessible of carbohydrate substances. They have been made available for precisely directed synthetical operations. Moreover, the simplicity and elegance of the new methods of investigation, the clarity of the logic that interprets the experimental results, and the unambiguous nature of the conclusions are such that the whole work is likely to become a classic example of organic chemistry at its best. The structure of the cyclic acetals of the carbohydrates is now a subject that could be most advantageously included as a special university lecture course for students of advanced organic chemistry. We are proud to think that Dr. Hann has played the dominant part in these advances and that his researches have shed fresh luster, not only upon his fellow workers at the National Institute of Health, but also upon his fellow members of the Chemical Society of Washington.

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PALEONTOLOGY.—*A Pleistocene pearl from southern Maryland.*[1] ROLAND W. BROWN, U. S. Geological Survey.

In a previous paper[2] I discussed the occurrence of pearls in species of *Inoceramus* found in Upper Cretaceous deposits of western Kansas and tabulated the known distribution of fossil pearls and pearllike objects of similar origin. Reference to my table (p. 370) discloses that, so far as known, only two Pleistocene pearls have been reported, one from *Mytilus edulis* and the other from

[1] Published by permission of the Director, U. S. Geological Survey. Received January 2, 1946.

[2] BROWN, ROLAND W. *Fossil pearls from the Colorado group of western Kansas.* Journ. Washington Acad. Sci. **30**: 365–374. 1940.

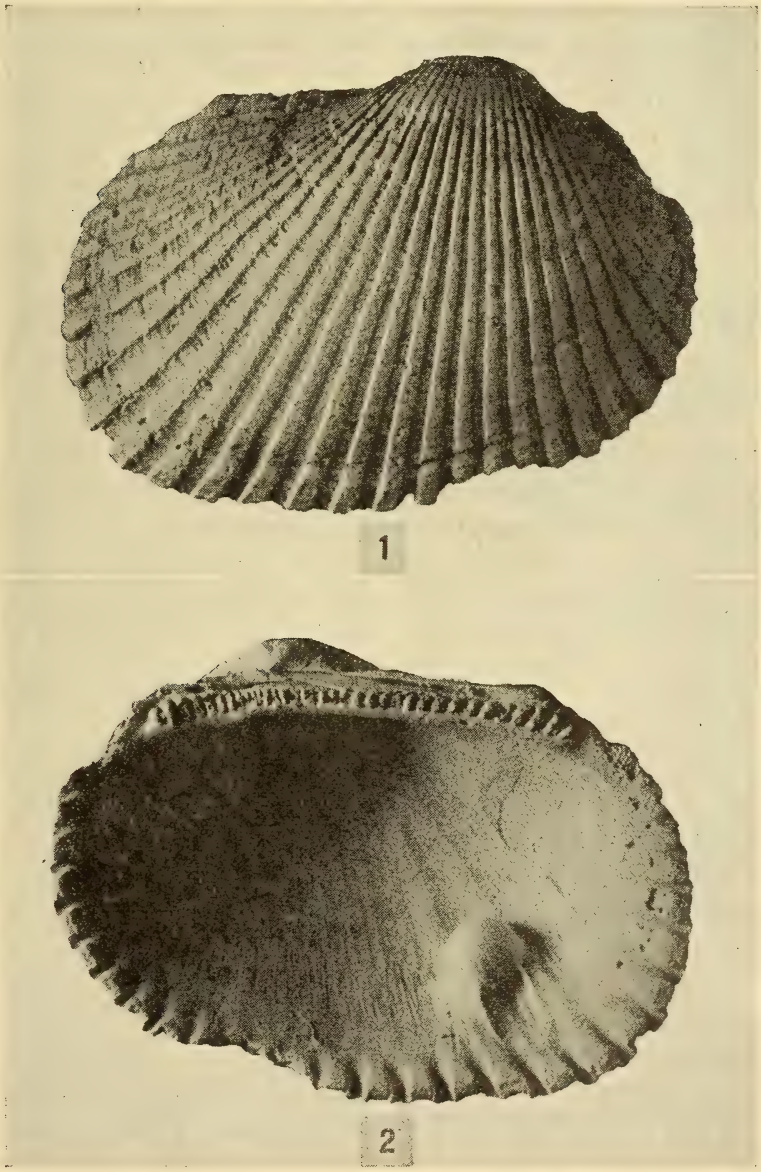


FIG. 1.—Exterior of right valve of *Arca transversa*. Fig. 2.—Interior of the valve, showing pearl. ×8. Photos by Nelson W. Shupe

Volsella modiolus, both from localities in the British Isles.

On November 7, 1942, I accompanied Dr. S. F. Blake, of the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, on a trip to Point Lookout, in southern Maryland. About 4 miles northwest of the Point the Potomac River has cut back into the land forming a long, low, vertical cliff called Wailes Bluff, well illustrated by Shattuck.[3] Exposed in the basal part at and a few feet above water level is compact, blue, sandy marine clay filled with Pleistocene shells. Resting on the blue clay is a lenticular oyster bed and well-stratified, horizontal, dark sandy clay overlain by light-colored cross-bedded sand and gravel belonging presumably to the Talbot terrace of the Pleistocene. Fragmentary leaves and pieces of wood may be had from the lower sandy clay strata of this unit.

At one spot in the lowermost beds along the bluff I found a large specimen of the snail *Busycon carica* that was filled with blue mud containing numerous small marine mollusks. Not long ago, cleaning out and breaking up this mud, now well dried, I uncovered a right valve (length, 1 cm) of *Arca transversa* to whose interior surface at the pallial line toward the posterior was attached an almost spherical pearl. As *Arca transversa* belongs to a genus whose species do not secrete nacre, or mother-of-pearl, this "pearl" is not a true pearl in the strict sense, although its mode of formation was otherwise undoubtedly similar to that of precious or ornamental pearls. The outside surface of the valve, directly under the pearl, is free of any scar or blemish, thus indicating that the inciting cause of the pearl was not a shell-borer. The location of the pearl at the pallial line just under the mantle, however, as well as its spherical shape, suggests strongly that a sand grain or other irritating object, either organic or inorganic, which the mollusk could not eject, was the cause.

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BOTANY.—*New bamboos from Szechwan Province, China.*[1]

YI-LI KENG and PAI-CHIEH KENG.[2] Department of Biology, National Central University, Chungking, China. (Communicated by AGNES CHASE.)

In this paper are described four new species and one new variety of Chinese bamboos. One of the species and the variety are known only from sterile specimens, while the descriptions of the other three species are based on their floral parts as well as on their vegetative organs. Illustrations have been prepared for the species with flowers. The types of all are deposited in the Herbarium of the Department of Biology of National Central University.

Sinocalamus distegius Keng & Keng f. sp. nov.

Fig. 1

Species evidenter cognata *Sinocalamo affini* (Rendle) McClure, ex qua culmo apice numquam pendulo, vaginis culmorum dorso inter pilos setosos valde pruinosis, vaginae nodo quando juvenili pilis retrorsis brunneis dense hirsuto, spiculis majoribus, et ovario pilis hirsutis brevioribus minoribus inferne obsito differt.

Arbor circa 10 m alta, 4.5 cm diametro, apice leviter arcuata sed haud pendula; internodia teretia, pleraque 20–50 cm longa, juvenilia superne leviter pruinosa et pilis albis adpressis deciduis hispida; vaginae culmorum coriaceae, late oblongae, circiter ½ longitudinem internodiorum aequantes, pleraeque pilis flavidis vel badiis, dense setosae et juveniles inter pilos farina alba graviter obsitae, basi persistente circa nodos earum annulo pilorum 2–3 mm longorum retrorsorum brunneorum post casum vaginarum facile deciduorum dense hirsutae; limbi longe triangulares vel lanceolati, saepissime erecti, inferiores minores rigidioresque, superiores majores malacioresque; rami numerosi, semiverticillati, ramulis plerisque folia nonnulla ad multa

[1] Received January 11, 1946.

[2] In a previous paper by these authors (Journ. Washington Acad. Sci. 35 (12): 374–378, figs. 1–18. 1945.) the junior author's other name, Keng Kwan-hou, was unfortunately used. He expects, however, to use the name Keng Pai-chieh in future publications, hence it is used here.

gerentibus; vaginae foliorum 35–48 mm longae, praeter basin ut in eis culmorum dense retorseque hirsutam glabrae; ligula 0.5–1 mm longa, truncata; laminae anguste lanceolatae, 5–16 cm longae, 8–16 mm latae, acuminatae, supra glabrae, infra pubescentes, utrinque nervis secundariis 4–6 percursae; rami floriferi aphylli vel folia pauca reducta laminis quam vaginis brevioribus ferentes; spiculae vel pseudospiculae solitariae vel saepe multae in glomerulum ad quemvis nodum facsiculatae, vel paucae vel plures in axillibus foliorum crescentes, 13–18 mm longae, 5–7 mm latae, 4–6-florae, lateraliter leviter compressae, ovato-lanceolatae, fuscae, pedicello circ. 0.5 mm longo fultae; rhachillae articuli 1–2 mm longi, glabri; glumae 1–2, lemmati similes sed multo breviores; lemmata chartacea, latissime ovata, 8–10 mm longa, glabra, multinervia, acuta, basi rotunda, ad margines dense ciliata; palea lemma aequans vel eo aliquanto brevior, bicarinata, inter carinas 2 mm lata binervisque, glabra sed ad carinas marginesque ciliata; lodiculae 3, una posteriore oblongo-ovata, duabus anterioribus dimidiato-ovatis, omnes circ. 2–4 mm longae (cilia includentes); stamina 6, ad maturitatem exserta, antheris pallide flavis, 5–6 mm longis, apice penicillatis, filamentis tenuibus, usque ad 8 mm longis; ovarium cano-albidum, pubescens, pyramidale vel conicum, ventraliter sulco lato canaliculatum, circ. 2.5 mm longum, ad maturitatem 2 mm crassum, stipite circ. 2.5 mm longo stipitatum; stylus subulatus, 2–3 mm longus, pubescens; stigmata 1–2, 5–6 mm longa, asperigilliformia; caryopsis cremeo-flava, fusiformis, circ. 6 mm longa, 3 mm lata.

Culms arborescent, somewhat arched but not drooping at apex, up to more than 10 m tall, 4.5 cm in diameter; internodes terete, greenish or yellowish at maturity, 20–50 cm or more long, the lower with a wall over 5 mm thick, pruinose above and beset with deciduous appressed whitish hairs when young; sheath-nodes prominent, densely hirsute with retrorse brownish hairs 2–3 mm long, but soon becoming glabrous and leathery after the culm-sheaths have fallen off; culm-nodes inconspicuous, dark-colored, 5–10 mm above the sheath-nodes; culm-sheaths coriaceous, 205×115, 250×185, 260×210 mm in size, about half as long as the internodes or less, densely setose with yellowish to brownish hairs (and when young also covered with a pruinose substance), except for a small glabrous area below the limb, the apex truncate, 2–6.5 cm wide, with rounded shoulders, the base broad, encircling the node once and a half; auricles inconspicuous, sometimes fimbriate with a few whitish setae about 3–5 mm long; ligule truncate, 1–2 mm long, denticulate, the teeth often prolonged into bristles 3 mm long; limb elongate-triangular to lanceolate, scarcely reflexed, the lower 13×5, 30×13, 32×18 mm in size and more rigid, the upper 80×28, 135×32 mm in size and much softer, acuminate with involute margins, constricted at base, glabrous and striate above, scaberulous beneath; branches numerous at each node, semi-verticillate, ascending to spreading, the internodes often 3–13 cm long, 2–3 mm thick, the branchlets bearing several to many leaves; leaf-sheaths straw-colored to brownish, 35–48 mm long, glabrous except the densely and retrorsely hirsute base, as in the culm-sheaths; ligule 0.5–1 mm long, truncate; blades narrowly lanceolate, 50×8, 126×16, 158×14 mm in size, acuminate, rounded or attenuate at base into a petiole 1–2 mm long, dull-green and glabrous above, pale-green and pubescent beneath, with 4–6 secondary nerves on each side, the margins scabrous; flowering branches aphyllous or bearing a few smaller leaves with blades 12–45 mm long, 2–7 mm wide; spikelets several to many at each node and clustered into globular fascicles, or few to several crowded in the axils of the sheaths, 13–18 mm long, 5–7 mm wide, laterally slightly compressed, ovate-lanceolate, dark brown, 4–6-flowered, the pedicel about 0.5 mm long; rachilla-joints 1–2 mm long, glabrous; glumes 1–2, resembling the lemmas but much smaller; lemmas chartaceous, very broadly ovate, 8–10 mm long and wide, glabrous, multinerved, rounded at base, acute, densely ciliate on the margins; palea equaling or somewhat shorter than the lemma, 2 mm wide and 2-nerved between the 2 keels, ciliate on the keels and the margins, otherwise glabrous; lodicles 3, the posterior one oblong-ovate, the anterior two dimidiate-ovate, all about 2–4 mm long (including the cilia); stamens 6, exserted at maturity, the anthers pale yellow, 5–6 mm long, penicillate at the apex, the filaments slender, up to 8 mm long; ovary grayish white, pubescent, pyramidal or conical, ventrally sulcate with a wide furrow, about 2.5 mm long,



FIG. 1.—*Sinocalamus distegius: 1* and *2*, Habit of flowering and leafy branches; *3*, culm-sheath, showing dorsal and ventral surfaces; *4*, pikelet; *5*, palea with rachilla-joint and flower, the lemma removed; *6*, stamen. (Type.)

2 mm thick at maturity, stipitate, the stipe about 2.5 mm long, glabrous; style subulate, 2–3 mm long, pubescent; stigmas 1–2, 5–9 mm long, aspergilliform; caryopsis cream-yellow, fusiform, about 6 mm long, 3 mm wide.

Type in the Herbarium of the Department of Biology, National Central University, Chungking, China, collected from stumps of a bamboo-grove, en route from Muh-tung, Pahsien to Pai-sha-ching, Nan-ch'uan-hsien, Szechwan Province, September 2, 1943, by *Keng & son* (no. 3865, a flowering specimen). Other collections of the same species are as follows.

Szechwan: Mount Omei, *H. C. Chow* 8714 (a flowering specimen); en route from Pahsien to Nan-ch'uan, *Keng & son* nos. 3864 (flowering specimen), 3897 (sterile specimen with culm-sheaths), 3898 (flowering specimen with culm), 3901 (flowering specimen with fruits and seedlings), and 3902 (a sterile specimen with leafy branches only).

This species much resembles *S. affinis* (Rendle) McClure in appearance and in the structure of the spikelets, but it differs remarkably in the culms' being erect or slightly arcuate at apex instead of long-pendulous, in the young culm-sheaths dorsally pruinose amongst the setae, and in the sheath-nodes densely hirsute with retrorse brownish hairs. The larger spikelets and the less pubescent ovary of this species also differentiate it from *S. affinis* which was originally described under *Dendrocalamus*.[3]

Sinocalamus farinosus Keng & Keng f. sp. nov.

Tametsi inflorescentia huius speciei ignota est, ea *S. affini* (Rendle) McClure et *S. distegio* nobis affinam esse apparet, ab utraque autem in internodiis culmorum brevioribus glabris sed quando juvenilibus albo-pruinosis, et in vaginis culmorum apice truncatis leviter rubro-bruneis cum ligula laciniata optime evoluta instructis differt.

Culmi usque at 10 m alti, 4–6 cm diam., apice leviter arcuati, cum muro circ. 5 mm crasso late fistulosi; internodia teretia, 10–20 cm longa, glabra, ante casum vaginarum viridia et omnino farina alba obsita, ad maturitatem flava lucidaque; nodi vaginarum basibus persistentibus cincti, quando juveniles infra ut supra eos annulo 3–5 mm lato pilorum velutinorum flavorum retrorsorum adpressorum obtecti; vaginae culmorum internodiis breviores vel ea circum aequentes, coriaceo-chartaceae, dorso pilis badiis 1–2 mm longis setosae, superne ciliatae, apice circiter 1.5–3 cm latae, truncatae vel leviter concavae; ligula optime evoluta, irregulariter laciniata, circ. 13 mm longa (longitudinem laciniarum includens); limbi reflexi, anguste lanceolati, 4–12 cm longi, 5–12 mm lati, glabri sed ad paginam superiorem marginesque scaberuli; rami ad quemvis nodum numerosi, adscendentes vel horizontales, primarii usque ultra 60 cm longi, ramulis folia 4–9 plerumque gerentibus; vaginae foliorum glabrae, 6–7.5 cm longae, efimbriatae; ligula truncata, circ. 1 mm longa; laminae tenues, lanceolatae, 9–17 cm longae, 15–25 mm latae, acuminatae, basi rotundae vel in petiolum 2 mm longum attenuatae, superne virides lucidaeque, inferne pallidiores minute pubescentesque, utrinque nervis secundariis 5–7 percursae, marginibus scabrae vel altero eorum fere laeves; inflorescentia desiderata.

Culms up to 10 meters tall, about 4–6 cm in diameter, with a wall about 5 mm thick, the internodes terete, 10–21 cm long, those of the young culms green but heavily whitish-pruinose with a ring (3–5 mm wide) of appressed velvety chestnut brown hairs becoming yellowish brown in age, just above and below the sheath-node, the hairs both retrorse and and antrorse below the node but antrorse only above it, the old culms entirely glabrate; sheath-node prominent, 3–5 mm below the inconspicuous culm-node above; culm-sheaths equaling or somewhat shorter than the internodes, reddish brown when young, becoming pale brown at maturity, triangular in outline, 15–21 cm wide, 14–21 cm long, coriaceo-chartaceous, but the margins much thinner, dorsally strigose with blackish hairs 1–2 mm long, truncate or slightly concave and about 1.5–3 cm wide at apex; ligule well developed, about 13 mm long (including the setae), irregularly laciniate into slender setae 7–10 mm long; auricles none; limbs small, reflexed, narrowly lanceolate, 4–12 cm long, 5–12 mm wide, acuminate, constricted near the base, the margins scaberulous, involute, thus rendering the tip subulate, glabrous and striate on the lower but scaberulous on the upper surface; branches numerous at each node, the main ones over

[3] *Dendrocalamus affinis* Rendle, Journ. Linn. Soc. Bot. **36**: 447. 1904.

60 cm long, 6–7-noded, with internodes 3–12 cm long, 3 mm thick, the intranode[4] about 5 mm long, whitish-pruinose and bearing a single shell-shaped bud; normal branchlets generally bearing 4–8 leaves; leaf-sheaths glabrous, 6–7.5 cm long, efimbriate, the sheath-nodes 5–7 mm distant; ligule truncate, about 1 mm long; blades thin, lanceolate, 9–17 cm long, 15–25 mm wide, acuminate, rounded or attenuate at base into a petiole 2 mm long, green and lustrous above, paler and minutely pubescent beneath, with 5–7 secondary nerves on each side, the margins scabrous or one of them nearly smooth; vigorous branchlets bearing over 10 much larger leaves, with whitish-pruinose internodes 2–3.5 cm long; leaf-sheaths keeled above, glabrous, but ciliate on the outer margins, 8.5–11 cm long; ligule truncate, 2–3 mm long, sometimes ciliate with few to several fimbriate bristles on one side; blades large, lanceolate or narrowly lanceolate, mostly 27×4.5 cm, rarely shortened to 14 cm long or narrowed to 2.5 cm wide, pale green and densely pubescent beneath, with 7–10 secondary nerves on each side, irregularly and inconspicuously tessellate, the margins setulose-scabrous; inflorescence wanting.

Type in the Herbarium of the Department of Biology, National Central University, Chungking, China, collected along open field-side in Fu-lu-kuan, en route from Nan-ch'uan city to Pai-sha-ching, Nan-ch'uan-hsien, Szechwan Province, September 9, 1943, by *Keng & son* (no. 3896). Another specimen of the same species was collected at Ch'ing-lung-tsu, en route from Pai-sha-ching, Nan-ch'uan-hsien to Shuang-tz'u-ch'ang, Pa-hsien of the same province, September 10, 1943, by *Keng & son* (no. 3899).

This species seems to be related to *S. affinis* and *S. distegius*, from both of which it differs, however, in having culms with shorter glabrous but whitish-pruinose internodes when young, and truncate somewhat reddish-brown culm-sheaths with very well developed laciniate ligules.

The vernacular name of this bamboo is "Liang-shan-tz'ŭ," but whether this bamboo was originally raised at Liang-shan-hsien, also a district of Szechwan, is uncertain. In the region where this species was collected, it often grows by the side of *S. distegius* but is less common than the latter. This bamboo is used at Nan-ch'uan as a material in paper-industry.

[4] A new word signifying the portion where the diaphragm grows inside the culm and from which the buds or branches arise. Its length is limited by the sheath-node below and the culm-node above.

Bambusa sinospinosa McClure var. **inermis** Keng & Keng f., var. nov.

Secundum culmi vaginas internodia arcte amplectantes, tarde deciduas, confertim coriaceas, quando juveniles virides sed pigmento aurentiaco leviter tinctas, ad maturitatem stramineas, longitudine striatas, et glabras sed basi circa nodos earum annulo 3–4 mm lato pilorum velutinosorum badiorum cinctas, haec planta *Bambusae sinospinosae* McClure proxime accedit. Ab specie posteriore haec varietas culmis ramisque inermibus solum recedit.

Culmi 3–5 m alti, usque ad 10 cm diametro; internodia teretia, juvenilia praesertim prope nodos pruinosa, viridia sed ut in vaginis culmorum pigmento aurantiaco leviter tincta, inferiora 25–30 cm longa; rami ad quemvis nodum 1–3, inermes, internodiis inferioribus 8–18 cm longis, circ. 7 mm crassis, angustissime fistulosis, ramulis folia nonnulla ferentibus; laminae foliorum longe ovatae vel lanceolatae, 11–24 cm longae, 28–45 mm latae, basi cuneatae, petiolo 3–5 mm longo fultae, subtus costam primam prominentem habentes, utrinque nervis secundariis 7–9 percursae; inflorescentia desiderata.

Culms 3–5 meters tall, up to 10 cm in diameter, the internodes terete or shallowly grooved on the gemmiferous side, glabrous but pruinose when young especially near the nodes, green or slightly orange-colored, the basal ones 25–30 cm long; sheath-node prominent with persistent sheath-base, about 5–8 mm (the length of intranode) below the elevated or inconspicuous culm-node; culm-sheaths tight, tardily deciduous, thickly coriaceous but thinner and membranous towards the margins, greenish and orange-tinged when young, stramineous at maturity, longitudinally striate, dorsally glabrous, but with a velvety ring of brownish hairs at base around the node, roughish and striate within; ligule well developed, membranous, about 5 mm long, erose; auricles none; limbs erect, dorsally glabrous as in the sheaths, setulose with brownish hairs between the nerves within especially towards the base, the margins involute, cartilaginous and

smooth; bud large, solitary, about semicircular in outline; branches 3 at each node, or only one through the abortion of the lateral ones, enclosed at base with a series of successively longer scales (the largest up to 8.5 mm long, pale stramineous, glabrous, dorsally keeled, obtuse or mucronate), the primary ones with basal internodes 8–17.5 cm long, about 7 mm in diam. with a calibre 2 mm across, bearing a few foliiferous branchlets with several to 10 leaves; leaf-sheaths about 8–12 cm long, pale brown, dorsally densely hispidulous with readily deciduous antrorse brownish hairs, truncate at apex, the margins scarious; ligule about 1 mm long, fringed at apex with fragile whitish bristles up to 5 mm long; blades ovate oblong to lanceolate, often cuneate at base with a petiole 3–5 mm long, acuminate, 11–24 cm long, 28–45 mm wide, deep green above, grayish green beneath, the midrib prominent, with 7–9 secondary nerves on each side, the cross veinlets inconspicuous, both margins scabrous; inflorescence wanting.

Type in the Herbarium of the Department of Biology, National Central University, Chungking, China, collected on slope in front of a cottage, enroute from Shuang-tz'ŭ-ch'ang to Mu-tung, Pa-hsien, Szechwan Province, September 10, 1943, by *Keng & son* (no. 3903). There are three sheets selected as the type of the species, one representing the culm, one the culm-sheath, and the other the leafy branch.

According to the shape, texture, and other characteristics of the culm-sheaths, and the branching system of the culm, this plant undoubtedly belongs to *Bambusa sinospinosa* McClure.[5] Since it bears no spines—the reduced hardened branches or branchlets—on the culm or branches, the epithet *inermis*, meaning unarmed, is taken as the varietal name.

Bambusa rigida Keng & Keng f., sp. nov.

Fig. 2

Species probabiliter affinis *Bambusae nanae* Roxburgh, ex qua culmo multo altiore crassioreque, internodiis glabris pruinosis, et culmi vagina cum auriculis duabus prominentibus fimbriatis appendiculata insigniter differt.

Culmi 5–10 m alti, 2–5 cm in diametro, erecti vel apice leviter arcuati, internodiis inferioribus 23–35 cm, superioribus usque ad 45 cm longis, anguste fistulosis, rigidis, glabris sed juvenilibus copiose albo-pruinosis; vaginae culmorum pallide brunneae, confertim chartaceae, pleraeque circ. ½ longitudinem internodiorum aequantes, tarde deciduae, dorso setis prompte deciduis badiis unilateraliter strigosae, apice truncatae vel leviter convexae, utrinque auriculatae, auricula maxime prominente, semiorbiculata, obscure brunnea, saepissime 5–15 mm longa, 15–30 mm lata, cum setis multis circ. 1 cm longis fimbriata; ligula 2–4 mm longa, aliquanto erosa vel dentata; limbi erecti vel reflexi, triangulares vel multo elongati, quam vagina facilius decidui et plerique breviores, ad paginam superiorem inter nervos minute setulosi; rami nonnulli vel multi, adscendentes vel patentes, primarii internodia inferiora 5–10 cm longa, 4–6 mm crassa habentes, ramulis superne folia 2–12 inferne vaginas 2–4 sine laminis ferentibus; vaginae foliorum 25–70 mm longae, arcte equitantes, striatae, glabrae sed apice setis 3–9 mm longis paucis deciduis saepe fimbriatae; ligula truncata, 0.5–1 mm longa; laminae tenues, aliquanto plicatae, oblongae vel anguste lanceolatae, 8–24 cm longae, 8–27 mm latae, tenuiter acuminatae, basi in petiolum 2–4 mm longum attenuatae, glabrae vel ad paginam inferiorem saepe puberulae, utrinque nervis secundariis 4–9 percursae sed non tessellatae; rami floriferi aphylli vel quando juveniles folia ferentes; spiculae ad quemvis nodum ramorum veteranorum plerumque multae in massam globularem aggregatae, sed eae in ramis juvenilibus solitariae vel nonnullae congestae, meliore evolutae, 3–4 cm longae, lucide virides vel stramineae, 3–5-florae, cum series squamarum deinceps longiorum subtentae; rhachillae articuli compressi, 2–4 mm longi, glabri sed apice cupulari inconspicue puberuli; gluma vel squama infra spiculam maxima circ. 6 mm longa, ovata, multinervis; lemmata lanceolata, 1–1.5 cm longa, 4–8 mm lata, glabra, dorso superne purpurea, multinervia, costa prima in carinam elevata; palea lemmate paullo brevior, cremea, bicarinata, inter carinas 2 mm lata 5-nervisque, carinis superne ciliatis; lodiculae 3, una posteriore lanceolata, duabus anterioribus dimidiato-ovatis, omnes circ. 3 mm longae, albo-scariosae, inferne nervosae, superne longe ciliatae; stamina 6, antheris linearibus, 4–6 mm longis, purpureis vel pallide flavis, apice penicillatis,

[5] Lingnan Sci. Journ. **19** (3): 411. *pl. 19.* 1940.

demum exsertis pendulisque, filamentis juvenilibus brevissimis, ad maturitatem usque ad 8 mm longis; ovarium triquetrum vel seriore globulare, stipitatum, circ. 2 mm longum, omnino pilis albidis hirtellum; stylus 1, puberulus, circ. 2 mm longus; stigmata 3, plumosa, brevissima; fructus immaturus.

Culms 5–10 m tall, 2–5 cm in diameter (breast high), erect or slightly arcuate at apex, the lower internodes 23–35 cm, the upper up to 45 cm long, narrowly fistulose with a calibre about 1.5–3 cm across and a wall 1–1.5 cm thick, rigid, glabrous but copiously whitish-pruinose especially when still enclosed by the sheaths; culm-sheaths pale brown, thickly chartaceous, generally about half the length of the internodes, tardily deciduous, dorsally strigose on one side with readily deciduous chestnut-brown setae, truncate or slightly convex at apex, auriculate on both sides, the auricles very prominent but often unequal in size, semicircular, dark brown, mostly 5–15 mm long, 15–30 mm wide, fimbriate with many bristles about 1 cm long; ligule 2–4 mm long, somewhat erose or dentate; limbs erect or reflexed, triangular or much elongate, more readily deciduous and generally shorter than the sheaths, dorsally glabrous or rarely setose as in the sheaths, minutely setulose between the nerves within (on the upper surface of the limb); branches several to many at each node, ascending or spreading, the primary ones with lower internodes 5–10 cm or more long, 4–6 mm thick, the branchlets 2 to several at each node of the relatively main axis, bearing 2–12 leaves above and 2–4 bladeless sheaths below; leaf-sheaths 25–70 mm long, those with blades keeled above, tightly overlapping, striate, glabrous but often fringed at apex with a few deciduous pale to blackish bristles 3–9 mm long; ligule truncate, 0.5–1 mm long; blades thin, somewhat plicate, oblong or narrowly lanceolate, 8–24 cm long, 8–27 mm wide, finely acuminate, attenuate at base into a petiole 2–4 mm long, glabrous or the paler lower surface frequently puberulent, with 4–9 secondary nerves on each side but with no cross veinlets, the margins scaberulous or one of them nearly smooth; floriferous branches aphyllous or with leaves when young; spikelets on young branchlets solitary or several together at each node, but on the old branches mostly numerous and crowded into a globular mass at a node, these crowded spikelets usually smaller, about 15 mm long, 3–4-flowered (all florets examined containing stamens only), subtended by many small scales, the solitary spikelets much better developed, 3–4 cm long, light-green or stramineous, 3–5-flowered, subtended by a series of successively longer scales; rachilla-joints compressed, 2–4 mm long, glabrous, but inconspicuously puberulent at the cupular apex; glume or the largest scale below the spikelet about 6 mm long, ovate, multinerved, the midnerve often keeled; lemmas lanceolate, 1–1.5 cm long, 4–8 mm wide, glabrous, dorsally purplish above, multinerved, the midrib elevated into a keel; palea slightly shorter than its lemma (in the crowded spikelets, the palea only about 5 mm long), creamy, 2-keeled, about 2 mm wide and 5-nerved between the keels, the latter ciliate above; lodicules 3, the posterior one lanceolate, the anterior two dimidiate-ovate, all about 3 mm long, whitish-scarious, nervose below, long-ciliate above; stamens 6, the anthers linear, purplish or light-yellow, 4–6 mm long, penicillate at apex, finally exserted and pendulous, the filaments about 1–2 mm long when young, but at maturity up to 8 mm long; ovary triquetrous or later becoming globular, stipitate, about 2 mm (including the stipe about 1 mm) long, entirely hirtellous with whitish hairs; style 1, puberulent, about 2 mm long; stigmas 3, plumose, less than 1 mm long; fruit immature.

Type in the Herbarium of the Department of Biology, National Central University, Chungking, China, collected on open roadside slope opposite the city of P'êng-shan-hsien, across the river of Min-chiang, Szechwan Province, August 17, 1942, by *Keng & son* (no. 3742). Three sheets of this number have been selected as type of this species, one representing the inflorescence, one the culm-sheaths, and the other the leafy branches. Other collections of the species are as follows:

Szechwan: Along river banks of Sun-ch'i-ho Chia-t'an-ch'ang, Chiang-ching-hsien, *M. C. Ts'eng* without number (flowering specimen collected November 29, 1939); on slope at right side of Ling-ying-ssŭ, Kuan-tu, Hoch'uan-hsien, April 4, 1943, *Keng f.* 5015 (flowering specimen); en route from Erh-t'ang to Ch'ing-liang-ssŭ, Pa-hsien, October 25, 1941, *Keng* 3681 (sterile specimen); open ground of the University campus, Sha-p'ing-pa,

Chungking, November 16, 1941, *Keng f.* 3692 (sterile specimen); Chang-chia-wan, T'ang-hsia-k'ou, T'ung-liang-hsien, altitude 700 meters, February 27, 1940, *K. S. Soo* 3 (sterile specimen).

This species is probably related to *Bambusa nana* Roxb.,[6] from which it is easily distinguished by the much taller and thicker habit, the glabrous but pruinose internodes, and by the culm-sheaths appendaged with 2 very prominent fimbriate auricles. The native name of this bamboo is "Y'ing-t'ou-huang" from its culms, which are rigid and with a small calibre. The culms are usually used as poles of sedan-chairs, but are not suitable for textile purposes.

[6] ROXBURGH, Fl. Ind. ed. Carey **2**: 190. 1824.

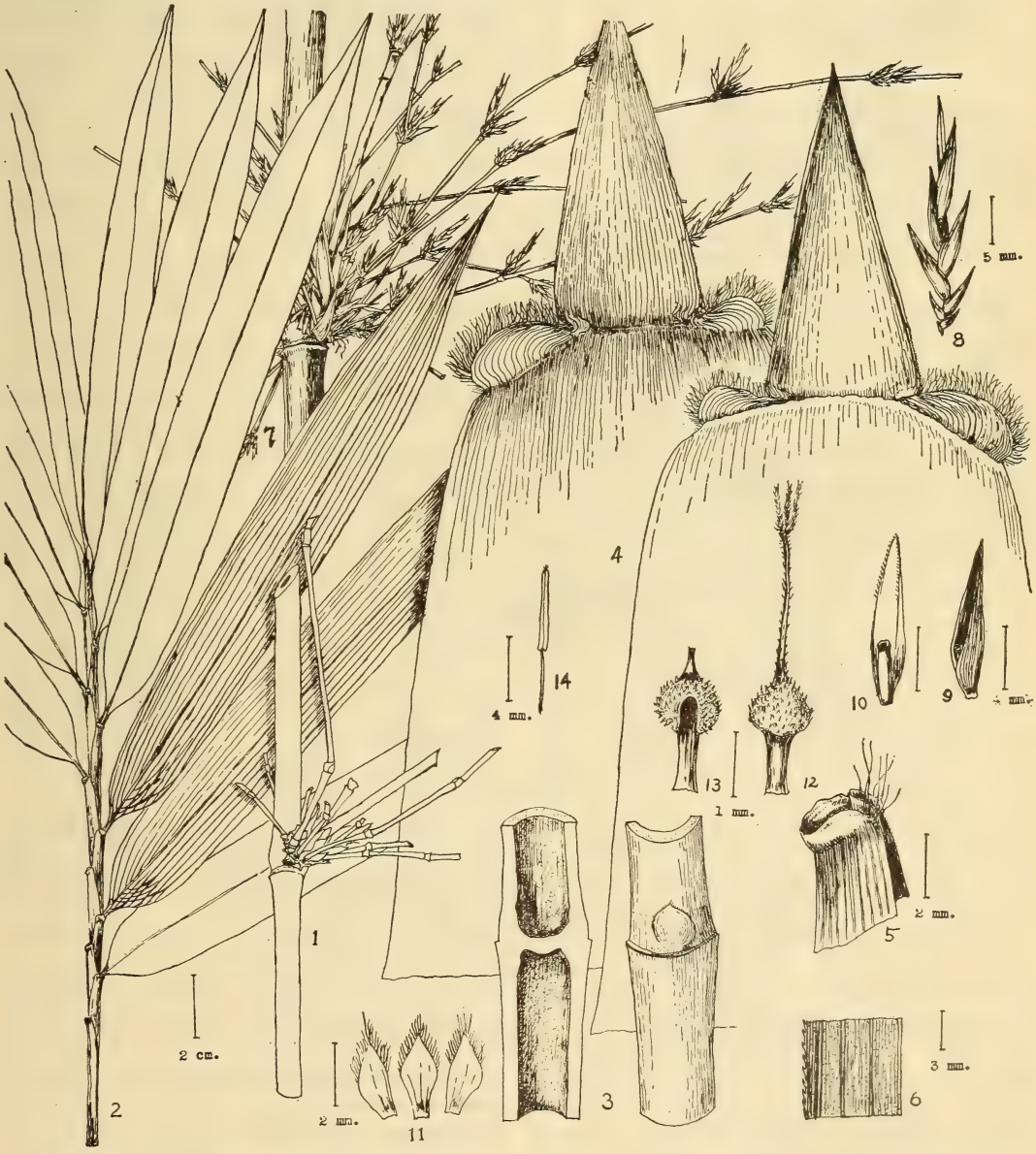


FIG. 2.—*Bambusa rigida: 1*, Habit of branching system; *2*, leafy branchlet; *3*, part of culm showing the diaphragm and bud of a node; *4*, culm-sheath showing dorsal and ventral surfaces; *5*, apex of leaf-sheath; *6*, part of lower surface of leaf-blade; *7*, upper part of culm with flowering branches; *8*, spikelet; *9*, floret; *10*, palea with rachilla-joint attached; *11*, lodicules; *12*, pistil; *13*, ventral view (the side facing the palea) of ovary; *14*, stamen. (Type.)

Bambusa fecunda McClure,[7] described from Hainan, bears the same vernacular name, but its scant description reveals that the culms are at first sericeous below the nodes and the limbs longer than the glabrous waxy culm-sheaths. The species here described has glabrous but farinose culms and prominently auriculate culm-sheaths mostly longer than the limbs.

Arundinaria pedalis Keng, sp. nov.

Fig. 3

Species *Arundinariae fargesii* E. G. Camus affinis, ex qua paniculis simplicibus vel racemis spicularum 4–8, et flosculis minoribus cum palea ejus lemma aequante instructis praecipue differt; laminae foliorum huius speciei etiam multo minores cum nervis secundariis pauciori-bus.

Suffrutex; internodia rhizomatis 5–20 mm longa, 2 mm crassa; culmi (inflorescentiam includentes) circ. 30 cm alti, internodiis inferioribus nudis, 1–5 cm longis, 1–1.5 mm crassis; vaginae foliorum 2–4.5 cm longae, equitantes, efimbriatae; ligula firma, circ. 1 mm longa; laminae herbaceo-chartaceae, 6.5–15 cm. longae, 9–17 mm latae, acuminatae, petiolis 2–4 mm longis fultae, nervis secundariis 5–7 utrinque percursae; inflorescentia spicularum 4–8 composita, inferne inclusa vel breviter exserta, 10–11 cm longa, rhacheos internodiis pubescentibus 1–3 cm longis; pedicelli compressi, erecti vel leviter adscendentes, circ. 2 mm vel inferiores usque ad 2 cm longi, dense praesertim versus apicem adpressi-pubescentes; spiculae 4–11-florae, 2–6 cm longae, 3–5 mm latae, fuscae vel fusco-brunneae, rhachillae articulis compressis, inter flores 4–5 mm longis, versus apicem dense adpressi-pubescentibus vel velutinis; glumae 3–4, membranaceae, superne pubescentes, prima 4–5 mm, tertia vel quarta 7–8 mm, longa; lemmata 7–10 mm longa, subulato-pungentia, callo pilis canis circ. 0.8 mm longis dense adpressi-pubescente; palea ejus lemma aequans, carinis infra apicem minute hispidulum leviter scaberulis, ceteroqui levibus; lodiculae 3 mm longae, superne fimbriatae; antherae 5–6 mm longae, nigrescentes vel purpureae; stigmata 2, pallida vel cremea, prope medium flosculi lateraliter exserta; caryopsis immatura.

[7] Lignan Sci. Bull. No. 9: 9. 1940.

Dwarf bamboos from monopodial horizontal rhizome with internodes 5–20 mm long, 2 mm thick; culms or leafy shoots about 15 cm tall, ending in 1–2 leaves with blades, frequently with solitary erect or ascending branches below, the lower internodes naked, 1–5 cm long, 1–1.5 mm thick; sheaths 3–5 towards the apex of the culms or branches, 2–4.5 cm long, equitant, efimbriate, glabrous or pubescent above, the outer margins usually ciliate; ligule firm, about 1 mm long, frequently fimbriate at its apex with setae 1–2 mm long; blades herbaceo-chartaceous, 6.5–15 cm long, 9–17 mm wide, acuminate, rounded or attenuate at the base into a petiole 2–4 mm long, glabrous or the paler lower surface puberulent when young, with 4–6 secondary nerves on either side, distinctly cross-veined, the margins setulose-scabrous above, nearly smooth below; flowering branches usually solitary at the lower nodes of the culm, 20–25 cm (including the inflorescence), long, 2-noded, the internodes up to 9 cm long, pubescent around the nodes, aphyllous but enclosed by sheaths 2.5–5 cm long; inflorescence a panicle or raceme of 4–8 spikelets, included below or shortly exserted, 10–11 cm long with pubescent rachis joints 1–3 cm long; pedicels (or branches) compressed, erect or somewhat ascending, about 2 mm or the lower ones up to 2 cm long, densely appressed-pubescent especially towards the apex; spikelets 4–11-flowered, 2–6 cm long, 3–5 mm wide, dusky or dark-brown; rachilla joints compressed, 4–5 mm long between the florets, densely appressed-pubescent or velvety towards the apex; glumes 3–4, membranous, successively longer, pubescent above, the first 4–5 mm, the third or fourth 7–8 mm long; lemma herbaceo-chartaceous, ovate-lanceolate, 7–10 mm long, more or less pubescent towards the subulate-pungent (rarely acute) apex, multinerved, reticulate between the nerves above, the callus densely appressed-pubescent with grayish hairs about 0.8 mm long; palea equaling its lemma, narrowly lanceolate with broad inflexed sides, the keels slightly scaberulous below the minutely hispidulous apex, otherwise smooth; lodicules 3, reddish-brown, oblong-lanceolate or the anterior two dimidiate-ovate, about 3 mm long, nervose, fimbriate above with longer stiff hairs at the apex; stamens 3, the anthers blackish or purplish, 5–6 mm long; stigmas 2, pale or creamy, about 3 mm long, laterally exserted



FIG. 3.—*Arundinaria pedalis: 1*, Habit; *2*, spikelet; *3*, floret, showing the lemma, palea, and rachilla-joint. (Type.)

near the middle of the floret; caryopsis immature.

Type in the Herbarium of the Department of Biology, National Central University, Chungking, China, a rare bamboo collected on rocky place, P'ang-ch'i, Chiang-pei-hsien, Szechwan Province, February, 1938, by *Ho Ching* (without number).

This small bamboo is probably related to *Arundinaria fargesii* E. G. Camus,[8] from which it differs mainly in having a simple panicle or raceme of 4–8 spikelets and smaller florets with palea equaling its lemma. The leaf-blades of this species are also much smaller and with fewer secondary nerves on each side than in the latter species.

REFERENCE LIST OF GEOGRAPHIC AND PERSONAL NAMES

Because of the near impossibility of locating on a map of China most geographic names given in romanization only, this reference list with characters is given. The characters are assembled here rather than given in the text in order to simplify the printing problem. American botany is now handicapped by the lack of precision of our early botanists in recording type localities. Although very few people, Chinese or westerners, at this time are interested in the precise type localities of Chinese species, it seems desirable to anticipate future needs and record these localities with all possible accuracy.—E. H. WALKER.

[8] *In* Lecomte, Not. Syst. **2** (fasc. 8): 244. 1912.

Ch'a-han-ch'eng 察汗城
Chang-chia-wan 張家灣
Chia-t'an-ch'ang 夾灘場
Chiang-ching-hsien 江津縣
Chiang-pei-hsien 江北縣
Ch'ing-liang-ssŭ 清涼寺
Ch'ing-lung-tsui 青龍嘴
Chou Hao-ch'ang 周鶴昌
Erh-t'ang 二塘
Fu-lu-kuan 福祿關
Ho Ching 何景
Ho-ch'uan-hsien 合川縣
Huang-yüan-hsien 湟源縣
Keng Kuan-hou 耿寬厚
Keng Pai-chieh 耿伯介
Keng Yi-li 耿以禮
Kuan-tu 官渡
Liang-shan-hsien 梁山縣
Liang-shan-tz'ŭ 梁山慈
Ling-ying-ssŭ 靈應寺
Min-chiang 岷江
Mu-tung 木洞
Nan-ch'uan-hsien 南川縣
Pa-hsien 巴縣
Pai-sha-ching 白沙井
P'ang-ch'i 磐溪
P'eng-shan-hsien 彭山縣
Sha-p'ing-pa 沙坪壩
Shuang-tz'ŭ-ch'ang 雙賜場
Su Chia-hsun 蘇甲薰
Sun-ch'i-ho 筍溪河
Tan-ka-êrh 丹噶爾
T'ang-hsia-k'ou 湯峽口
Ts'eng Mien-chih (Tsen Mill) 曾勉之
Tung-liang-hsien 銅梁縣
Ying-t'ou-huang 硬頭黃

ENTOMOLOGY.—*Synopsis of the cerambycid beetles of the genus* Stenosphenus *Haldeman found in America, north of Mexico.*[1] W. S. FISHER, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. MUESEBECK.)

In the process of studying and rearranging the species of *Stenosphenus* in the United States National Museum, it was found that the genus had not been treated in a synoptical way since 1885, when Horn published a table for separating the six known species. This table was republished by Leng in 1887. Since that time one species has been described by Schaeffer, five species by Casey, and four species by Linsley, and it seems advisable to bring our knowledge of the genus up to date.

[1] Received January 11, 1946.

Genus **Stenosphenus** Haldeman

Stenosphenus Dejean, Cat. Coléopt., ed. 3, p. 330 (nomen nudum). 1835; ed. 3, rev., p. 355 (nomen nudum). 1836; Haldeman, Trans. Amer. Phil. Soc. (ser. 2) **10**: 39. 1847; Chevro-

lat, *in* d'Orbigny, Dict. Hist. Nat. **12**: 13–14. 1848; Melsheimer, Cat. Coleopt. U. S., p. 104. 1853; Thomson, Classification Cérambycides, p. 372. 1860; Systema Cerambycidarum, p. 433. 1864; Lacordaire, Genera des Coléopt. **9**: 122, 130. 1869; Gemminger and Harold, Cat. Coleopt. **9**: 2957. 1872; Crotch, Check List Coleopt. North Amer., p. 87. 1873; LeConte, Smithsonian Misc. Coll. No. 265: 316–317. 1873; LeConte and Horn, Smithsonian Misc. Coll. No. 507: 301–302. 1883; Henshaw, List Coleopt. North Amer., p. 98. 1885; Horn, Trans. Amer. Ent. Soc. **12**: 177–180. 1885; Leng, Ent. Amer. **2**: 193–194. 1887; Henshaw, List Coleopt. North Amer., suppl. 3, pp. 24, 51. 1895; Blatchley, Coleoptera of Indiana, pp. 1031–1032. 1910; Aurivillius, *in* Schenkling, Coleopt. Cat., pt. 39, pp. 443–444. 1912; Leng, Cat. Coleopt. North Amer., pp. 278, 359. 1920; Leng and Mutchler, Cat. Coleopt. North Amer., suppl. 1, p. 42. 1927; Linsley, Ann. Ent. Soc. Amer. **29**: 477–478. 1936; Blackwelder, Cat. Coleopt. North Amer., suppl. 4, pp. 57, 59. 1939.

The bibliography given above for the genus is not complete, since only the more important articles are cited, especially those dealing with the United States species. In the papers by Melsheimer (1853), Lacordaire (1869), Gemminger and Harold (1872), Crotch (1873), Henshaw (1885, 1895), Aurivillius (1912), Leng (1920), Leng and Mutchler (1927), and Blackwelder (1939), a number of species of *Stenosphenus* are listed, but since these publications are only catalogues the citations are omitted from the bibliographies of the species.

The name *Stenosphenus* was first used by Dejean (1835) in his Catalogue des Coléoptères, where he included three species of which no descriptions had been published. Haldeman (1847) published a description of the genus, citing *Stenosphenus* Dej. Cat., including only *Callidium notatum* Olivier, under which he placed *discicollis* Dej. (nomen nudum) as a synonym. Thomson (1860, 1864), not knowing of the paper by Haldeman, likewise described *Stenosphenus* Dej. Cat. He also described *Stenosphenus cribripennis* Dej. Cat. (nomen nudum) and designated it as the type of *Stenosphenus* Thomson.

There has been considerable confusion in regard to the position of this genus in the family Cerambycidae. Lacordaire (1869) placed *Stenophenus* in the tribe Heteropsini, and was followed by Aurivillius (1912). LeConte (1873) proposed the tribe Stenosphenini for the genus *Stenosphenus*, placing it between the tribes Clytini and Phoracanthini, and stating that its affinities are equally with *Cyllene* and *Elaphidion*. Casey (Mem. Coleopt. **3**: 346. 1912) stated that "the spinose antennae suggests some of the next tribe (Clytini), and other features recall *Elaphidion*, but, on the whole, it is very isolated and without close allies." Linsley (1936) transferred the genus *Stenosphenus* from the tribe Heterospini to the tribe Sphaerionini, near the genus *Ironeus* Bates.

DESCRIPTION OF THE GENUS

Head small, flat between antennae, slightly declivous, front elongate; cheeks short; eyes finely granulated, deeply emarginate; antennal tubercles not or only slightly elevated. Antenna inserted on front more or less distant from mandibles, usually shorter than body in females, longer than body in males, slender, punctured, pubescent, and sparsely clothed with flying hairs; intermediate segments of males longitudinally carinate in some species; segment 1 robust, gradually expanded toward apex; segment 2 small; segment 3 longer than 4, which is subequal in length to each of the following segments, except 11, which is longer than segment 10 in the males; segments 3 to 7 or 8 spinose at apices on inner side. Palpi short, subequal in length, last segments nearly cylindrical at apices, not impressed. Pronotum rounded at sides, usually more strongly narrowed anteriorly, without spines or callosities. Scutellum broadly rounded at apex. Elytra elongate, slightly convex above; sides subparallel, rarely strongly narrowed posteriorly; tips truncate, or emarginate with the angles spinose; epipleura entire at base. Anterior coxae globose, not angulated externally. Middle coxal cavities closed externally. Prosternal process suddenly declivous and perpendicular at apex. Mesosternum broad, suddenly declivous anteriorly, truncate or emarginate posteriorly. Legs rather short; femora slightly expanded toward apices, not spinose at apices, posterior pair shorter than elytra; tibia longitudinally carinate; first segment of posterior tarsus as long as following two segments united.

Genotype.—*Callidium notatum* Olivier.

Stenosphenus is a moderately large genus, distributed throughout eastern Canada, eastern and southwestern United States, Mexico, Central America, and Cuba.

The differences in the sculpture of the prosternum in the two sexes are quite distinct, except in *notatus* and *pinorum*, both of which have the pronotum distinctly wider than long, widest at the middle, and the sides broadly rounded. In these two species the prosternum is vaguely punctured and feebly rugose in both sexes. In most of the species the depressed space extends from one side of the prosternum to the other and is coarsely punctured in the males. This space does not extend to the anterior margin and is usually divided into two parts by a smooth space extending from the anterior margin to the apex of the prosternal process. In the females the prosternum may be vaguely punctured, feebly rugose, or almost smooth. I cannot agree with Schaeffer (Journ. New York Ent. Soc. **19**: 125. 1911) that the sculpture on the prosternum in front of the coxae is very variable and cannot be relied upon for separating the species, for in examining large series of various species I found this character rather constant. *Stenosphenus beyeri* Schaeffer is the only species in which this character can be considered as variable; usually the depression is not separated by a smooth space, but at the most this space is very narrow.

KEY TO THE SPECIES OF STENOSPHENUS

1. Pronotum distinctly wider than long, equal in width at base and apex....2
   Pronotum as long as, or longer than, wide, at most only slightly wider than long, narrower at apex than at base....5
2. Femora red....3
   Femora black....4
3. Pronotum coarsely punctate, with a smooth median vitta; elytra black...*aridus* Linsley
   Pronotum not distinctly punctate; elytra chestnut brown....*castaneus* Casey
4. Pronotum unicolored, red or yellow....*pinorum* Casey
   Pronotum bicolored, red, with a blackish, median spot....*notatus* (Olivier)
5. Body uniformly brownish or reddish yellow.6
   Body not uniformly brownish or reddish yellow, but black to reddish brown, usually with the pronotum more reddish....7
6. Pronotum distinctly longer than wide; antenna with intermediate segments black, and one and one-fourth times as long as body in the male....*nigricornis*, n. sp.
   Pronotum not longer than wide; antenna uniformly brownish yellow and only slightly longer than body....*debilis* Horn
7. Femora entirely black....8
   Femora in greater part red or reddish yellow....10
8. Punctures and pubescence on elytra arranged in longitudinal spaces, which are separated by longitudinal smooth intervals....*lugens* LeConte
   Punctures and pubescence on elytra uniformly distributed....9
9. Pronotum distinctly punctured; tips of elytra truncate....*beyeri* Schaeffer
   Pronotum not distinctly punctured; tips of elytra bispinose....*dolosus* Horn
10. Elytra black....11
    Elytra reddish brown....14
11. All femora reddish....12
    Only posterior femora reddish. Antenna not longer than body in male, shorter than body in female; male with punctured depression on prosternum not separated by a smooth median area....*rossi* Linsley
12. Pronotum distinctly punctured; tips of elytra strongly bispinose....*novatus* Horn (*lucanus* Casey)
    Pronotum not distinctly punctured; tips of elytra not strongly bispinose....13
13. Antenna shorter than body in both sexes....*basicornis* Linsley
    Antenna at least as long as body in female, longer than body in male....*lepidus* Horn
14. Pronotum distinctly punctured; tibiae pale reddish brown....*pruddeni* Casey
    Pronotum not distinctly punctured; tibiae black....15
15. Male with punctured depression on prosternum separated by a smooth median area; tips of elytra emarginate, bispinose. Female unknown....*arizonicus* Linsley
    Male with punctured depression on prosternum not separated by a smooth median area; tips of elytra not emarginate or distinctly bispinose. Female unknown....*longicollis* Casey

Stenosphenus aridus Linsley

Stenosphenus aridus Linsley, Ent. News **46**: 166. 1935.

Black, strongly shining; prothorax and femora rufous, the former at sides and apex and latter at apices slightly piceous. Pronotum transverse, rounded at sides, coarsely, irregularly punctate at sides, smooth at middle. Elytra rather coarsely, uniformly punctate, rather densely, uniformly clothed with long, semierect, pale hairs, apices emarginate, outer angles dentiform. Prosternum in male coarsely punctate and depressed on each side of median, smooth carina. Female unknown. Length 10 mm, width 2.5 mm. This species has not been seen by the writer and has been placed in the key entirely upon the characters given in the original description.

Type locality.—Zion National Park, Utah.

Type.—In the California Academy of Sciences.

This species was described from two males reared from small branches of *Populus fremontii* collected at the type locality, May 16–21, 1934, by Donald DeLeon.

Stenosphenus castaneus Casey

Stenosphenus castaneus Casey, Mem. Coleopt. **11:** 269. 1924.

Uniformly reddish brown; the thorax slightly more reddish, strongly shining. Pronotum widest at middle; sides broadly rounded; surface nearly impunctate, with a few punctures toward sides, and a few rather long, inconspicuous hairs. Elytra finely, sparsely, uniformly punctate, sparsely clothed with moderately long, semierect, fine, inconspicuous hairs, apices obliquely truncate, the lateral angle spinose, sutural angle slightly produced. Prosternum in female feebly, transversely rugose, and indistinctly punctate, not depressed. Length 10.5 mm, width 3 mm.

Type locality.—Texas, locality unrecorded.

Type.—In the Casey Collection, United States National Museum.

This species was described from a single female. In the Museum Collection there is a male specimen, which is labeled Capitan Mountains, New Mexico, and which agrees with the type except that the antennae and legs are slightly darker, and the prosternum is depressed and coarsely, rather densely punctured and separated at the middle by a smooth, longitudinal elevation.

Stenosphenus pinorum Casey

Stenosphenus pinorum Casey, Mem. Coleopt. **11:** 268–269. 1924.

Black to reddish black, strongly shining; prothorax and underside of head uniformly reddish yellow. Pronotum widest at middle; sides broadly rounded; surface indistinctly punctate, sparsely clothed, especially at sides, with short, recumbent, yellowish-white hairs. Elytra sparsely, uniformly, finely punctate, sparsely, uniformly clothed with short, semierect, whitish hairs; apices separately emarginate, both angles acute, the lateral tooth slightly longer than sutural one. Prosternum indistinctly punctate in both sexes. Length 9.5–16 mm, width 4–2.5 mm.

Type locality.—Southern Pines, N. C.

Type.—In the Casey Collection, United States National Museum.

This species was described from a single male collected by Abram H. Manee. Specimens have been examined from Florida, District of Columbia, New Jersey, North Carolina, and Virginia. This species has been reared from hickory (*Hicoria* spp.).

Stenosphenus notatus (Olivier)

Callidium notatum Olivier, Entom., Gen. 70, **4:** 61, pl. 7, fig. 89. 1795.

Stenosphenus notatus Haldeman, Trans. Amer. Phil. Soc. (ser. 2) **10:** 39. 1847; Horn, Trans. Amer. Ent. Soc. **12:** 178, 180. 1885; Leng, Ent. Amer. **2:** 193. 1887; Hamilton, Can. Ent. **20:** 66. 1888; Insect Life **4:** 130. 1891; Wickham, Can. Ent. **29:** 149. 1897; Blatchley, Coleoptera of Indiana, p. 1032. 1910; Craighead, Canada Dept. Agr. (new ser.) Bull. 27 (Ent. Bull. 23): 72–73, pl. 15, fig. 8, pl. 21, fig. 6. 1923.

Elaphidion notatum LeConte, Journ. Acad. Nat. Sci. Philadelphia (ser. 2) **2:** 12. 1850.

Elaphidion deflendum Newman, Entomologist, London, **1:** 6. 1840; Haldeman, Proc. Amer. Phil. Soc. **4:** 376. 1847.

Stenocorus discoideus Sturm, Cat. Ins. Samml., p. 199. 1826.

Stenosphenus discicollis Dejean, Cat. Coleopt., ed. 3, p. 330. 1835; ed. 3, rev., p. 355. 1836.

Black, strongly shining; pronotum and underside of head reddish yellow, the former with large discal black spot. Pronotum widest at middle; sides feebly, broadly rounded; surface indistinctly punctate, sparsely clothed, especially at sides, with short, recumbent, yellowish-white hairs. Elytra finely, sparsely, uniformly punctate, sparsely, uniformly clothed with short, semierect, whitish hairs; apices separately emarginate, both angles acute, the lateral tooth slightly longer than sutural one. Prosternum indistinctly punctate in both sexes. Length 9–16 mm, width 2.5–4 mm.

Type locality.—Of *notatum,* New York. Of *deflendum,* Georgia. Of *discicollis* and *discoideus,* Amerique borealis.

Types.—*S. notatus,* probably in Paris Museum; *deflendum* and *discicollis,* in the British Museum; *discoideus,* in the Munich Museum before the war.

This species is widely distributed throughout the eastern part of Canada and the United States, as far west as the Rocky Mountains. It is very common, breeding in the dead limbs of hickory and pecan, and rarely in *Celtis* sp.

The larvae bore into the dead limbs of its host plants, pupating the latter part of the second year, and becoming adults before winter, but remaining in the wood until the following spring.

Stenosphenus nigricornis, n. sp.

Male.—Elongate, slender, slightly flattened, moderately shining, uniformly brownish yellow, except intermediate segments of antenna, which are black, and head and pronotum, which are slightly more reddish.

Head coarsely, irregularly, rather densely punctate, with a narrow, median groove extending from occiput to clypeus; antennal tubercles shining, scarcely punctate. Antenna one and one-fourth times as long as body; segments 3 to 7 spinose at apices, the spines gradually decreasing in length toward apex of antenna, sparsely clothed with short, recumbent, white hairs with a few longer, semierect hairs intermixed; segment 1 cylindrical, slightly expanded toward apex; segment 3 one and one-half times as long as segment 1, the following segments gradually diminishing in length except the eleventh, which is longer than tenth.

Pronotum distinctly longer than wide, slightly narrower at apex than at base; sides slightly rounded; surface sparsely, coarsely, irregularly punctate, sparsely clothed at sides with short, recumbent, and long, erect, whitish hairs.

Elytra at base slightly wider than pronotum at middle; sides feebly converging from bases to near tips, which are separately transversely, sinuately truncate, with sutural and lateral angles slightly produced; surface densely, coarsely, uniformly punctate, the punctures separated by about their own diameter, rather densely, uniformly clothed with long, semierect, white hairs.

Abdomen beneath smooth; nearly impunctate, rather densely clothed at sides with moderately long, recumbent, white hairs; last sternite truncate at apex. Prosternum smooth in front, the very coarsely punctured area not divided at middle by a smooth median area.

Length 9 mm, width 2 mm.

Type locality.—Yuma, Calif.

Type.—In the United States National Museum, no. 57688.

Described from a single male collected during August by H. F. Wickham.

This species is closely allied to *Stenosphenus debilis* Horn, but it differs from that species in having the intermediate segments of the antenna black and the pronotum distinctly longer than wide.

Stenosphenus debilis Horn

Stenosphenus debilis Horn, Trans. Amer. Ent. Soc. **12**: 178, 179–180. 1885.

Uniformly brownish or reddish yellow, subopaque. Pronotum widest at middle, broadly rounded at sides, coarsely, sparsely, irregularly punctate, sparsely clothed with short, semierect, whitish hairs. Elytra rather densely, finely, uniformly punctate, sparsely, uniformly clothed with short, semierect, yellowish-white hairs; apices separately obliquely, sinuately truncate, the outer angle short and acute. Prosternum in male rather densely, coarsely punctate, not separated at middle by a smooth space, in female very finely, transversely rugose and punctate. Length 7.5–12 mm, width 2–3 mm.

Type locality.—Utah, locality unrecorded.

Type.—In Horn Collection, Academy of Natural Sciences of Philadelphia.

This species was described from two males. Specimens of both sexes have been examined which were collected in Utah by E. Palmer and by Hubbard and Schwarz. The females are slightly more robust than the males, and the antennae are slightly shorter than the body. Horn states that the pronotum is longer than wide, although in all the specimens examined the pronotum is as wide as long. The type has not been examined.

Stenosphenus lugens LeConte

Stenosphenus lugens LeConte, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 41; Horn, Trans. Amer. Ent. Soc. **12**: 178, 180. 1885; **13**: Proc. p. xii. 1886; Leng, Ent. Amer. **2**: 193. 1887; Schaeffer, Journ. New York Ent. Soc. **19**: 125. 1911.

Stenosphenus hirsutipennis Bates, Trans. Ent. Soc. London, 1872, p. 191 (note); Biol. Centr.-Amer., Coleopt., **5**: 67. 1880; p. 313, 1885.

Black, shining; head and thorax red. Pronotum widest at middle, broadly rounded at sides, nearly impunctate and glabrous. Elytra, rather coarsely, uniformly punctate, sparsely, uniformly clothed with short, semierect, yellowish-white hairs; the punctures and hairs arranged in longitudinal spaces separated by

smooth intervals; apices separately emarginate; angles acute, the lateral tooth slightly longer than sutural one. Prosternum in male very coarsely, sparsely punctate at sides, separated at middle by a smooth, longitudinal elevation, in the female smooth and indistinctly punctate. Length 10–14 mm, width 2.5–3.5 mm.

Type locality.—Of *lugens*, Texas, no definite locality. Of *hirsutipennis*, Mexico, no definite locality.

Type.—*S. lugens*, in LeConte Collection, Museum of Comparative Zoology; *hirsutipennis*, in the British Museum.

A series of adults has been examined from Brownsville, Tex., and a number of other specimens labeled *hirsutipennis* from Jalapa and Alomolonga, Mexico. All these specimens were identical, and uniform in coloration. The adults have been reared from Huisache (*Acacia farnesiana*) collected at Brownsville, Tex.

Bates (1885) stated that *hirsutipennis* differed from *lugens* in having a red thorax, but this statement is incorrect, since both species have the thorax red, and Horn (1886) placed *hirsutipennis* Bates (1872) as a synonym of *lugens* LeConte (1862).

Stenosphenus beyeri Schaeffer

Stenosphenus beyeri Schaeffer, Brooklyn Inst. Mus., Sci. Bull. **1** (7): 163–164. 1905; Journ. New York Ent. Soc. **19**: 125. 1911.

Black, strongly shining; prothorax entirely black or in part red. Pronotum widest at middle; sides broadly rounded; surface coarsely, densely, irregularly punctate, sparsely clothed with short, semierect, inconspicuous hairs. Elytra densely, finely, uniformly punctate, rather densely clothed with short, semierect, yellowish-white hairs; apices transversely truncate, the angles not produced. Prosternum in male opaque, coarsely, densely punctate and at most only separated at middle by a very narrow, longitudinal smooth space, in the female moderately shining, transversely rugose, and sparsely punctate. Length 10.5–13.5 mm, width 2.75–3.5 mm.

Type locality.—Palmerlee, Cochise County, Ariz.

Lectotype.—In the United States National Museum.

Schaeffer described this species from a series of specimens and labeled them all types without selecting a holotype. A female collected at the type locality during August is here selected as the lectotype.

Adults have been examined from the following localities in Arizona: Miller's Canyon, Huachuca Mountains, Santa Catalina Mountains, Redington, and Prescott National Forest. There is one specimen in the collection labeled simply "N. M." The pronotum varies in color from uniformly black or red to red with the anterior and posterior margins black. This species has been reared from New Mexico locust (*Robinia neomexicana*) and little walnut (*Juglans rupestris*).

Stenosphenus dolosus Horn

Stenosphenus dolosus Horn, Trans. Amer. Ent. Soc. **12**: 178, 179. 1885; Leng, Ent. Amer. **2**: 193, 194. 1887; Schaeffer, Journ. New York Ent. Soc. **19**: 125. 1911.

Reddish brown, strongly shining; prothorax red; legs black. Pronotum widest at middle; sides broadly rounded; surface indistinctly punctate and nearly glabrous. Elytra finely, densely, uniformly punctate, rather densely, uniformly clothed with short, semierect, whitish hairs; apices separately obliquely truncate; the lateral angle short and acute; sutural angle slightly produced. Prosternum with the densely, finely punctured depression separated at middle by a narrow, smooth, longitudinal elevation in the male; feebly, transversely rugose, and indistinctly punctate in the female. Length 7–14 mm, width 2–3.5 mm.

Type locality.—Southwestern Texas.

Type.—In the Horn Collection, Academy of Natural Sciences of Philadelphia.

Described from both sexes. A large series of adults have been examined from various localities in Texas. The species has been reared from mesquite (*Prosopis juliflora*) and *Acacia* sp. The coloration is uniform in the large series of adults examined.

Stenosphenus rossi Linsley

Stenosphenus rossi Linsley, Proc. California Acad. Sci. (ser. 4) **24**: 45–46, pl. 4, fig. 8. 1942.

Black, shining; posterior femora reddish. Pronotum narrowed anteriorly, rounded at sides, surface nearly impunctate, glabrous except for a few erect hairs at sides. Elytra coarsely but not closely punctate, clothed with moderately long, semierect hairs; apices separately emarginate; the angles acute or sub-

spiniform. Prosternum with depression coarsely punctate, but not separated at middle by a smooth, longitudinal elevation in male, depression vague, finely rugose, and punctate in female. Length 7.5–8.5 mm, width not given.

This species is not represented in the National Museum Collection and has been given its position in the key from the characters given in the original description.

Type locality.—San Domingo, Lower California.

Type.—In the California Academy of Sciences.

This species was described from 16 specimens collected on a flowering leguminose shrub at the type locality, July 19, 1938, by A. E. Michaelbacher and E. S. Ross.

Stenosphenus novatus Horn

Stenosphenus novatus Horn, Trans. Amer. Ent. Soc. **12**: 178–179. 1885; Leng, Ent. Amer. **2**: 193. 1887; Horn, Proc. California Acad. Sci. (ser. 2) **4**: 338. 1894; Schaeffer, Journ. New York Ent. Soc. **19**: 125. 1911; Grossbeck, Bull. Amer. Mus. Nat. Hist. **31**: 325. 1912; Linsley, Pan-Pacific Ent. **10**: 60. 1934; Proc. California Acad. Sci. (ser. 4) **24**: 44–45. 1942.

Stenosphenus lucanus Casey, Mem. Coleopt. **3**: 346. 1912.

Black, moderately shining; thorax and femora red, the former sometimes with anterior and posterior margins blackish. Pronotum widest at middle; sides rounded, more strongly narrowed anteriorly; surface coarsely, sparsely, irregularly punctate, nearly glabrous. Elytra rather densely, coarsely, uniformly punctate, sparsely, uniformly clothed with very short, semierect, white hairs; apices separately deeply emarginate, angles spiniform, the lateral spine longer than sutural one. Prosternum in male with two densely, finely punctured depressions separated at middle by a smooth, longitudinal elevation, in the female very finely rugose and punctate, but not depressed. Length 9.5–12.5 mm, width 2.5–3.5 mm.

Type locality.—Of *novatus*, Cape San Lucas, Lower California. Of *lucanus*, Lower California, no definite locality.

Type.—*S. novatus*, in the Horn Collection, Academy of Natural Sciences of Philadelphia; *lucanus*, in the Casey Collection, United States National Museum.

Casey described *lucanus* from a single male, which is identical with specimens of *novatus* from the Cape Region of Lower California. A good series of adults, which show no variations in color, has been examined from the following localities in Lower California: Santa Rosa, San José del Cabo, and Purissima. Linsley (1942) records it from Miraflores and San Pedro, Lower California.

Stenosphenus basicornis Linsley

Stenosphenus basicornis Linsley, Pan-Pacific Ent. **10**: 60. 1934; Proc. California Acad. Sci. (ser. 4) **24**: 45, 1942.

Rufous, shining; elytra and abdomen black; femora rufous, tibiae piceous at bases, black at apices; antennal segments 1 and 2 rufous, following segments piceous. Pronotum narrowed anteriorly, rounded at sides; surface smooth with a few scattered punctures, and erect, pale hairs. Elytra coarsely, uniformly, sparsely punctate, clothed with semierect, pale hairs, apices sinuately truncate, the angles dentiform. Prosternum coarsely, cribrately punctate at sides, and separated at middle by a shining, longitudinal line in the male, finely and densely punctate in female. Length 7.3 mm, width 2.5 mm.

This species is unknown to the writer, and has been placed in the key entirely upon the characters given in the original description.

Type locality.—Tiburón Island, Gulf of California.

Type.—In the California Academy of Sciences.

This species was described from three specimens collected on a species of mesquite (*Prosopis* sp.) at the type locality July 5, 1921, by E. P. Van Duzee.

Stenosphenus lepidus Horn

Stenosphenus lepidus Horn, Trans. Amer. Ent. Soc. **12**: 178, 179. 1885; Leng, Ent. Amer. **2**: 193, 194. 1887; Casey, Ann. New York Acad. Sci. **6**: 34–35. 1891; Schaeffer, Journ. New York Ent. Soc. **19**: 124–125. 1911.

Black, shining; femora red, sometimes blackish at apices; thorax entirely red or black, sometimes red with anterior and posterior margins black. Pronotum widest at middle, broadly rounded at sides; surface sparsely, indistinctly punctate and nearly glabrous. Elytra rather coarsely, sparsely, uniformly punctate, sparsely, uniformly clothed with short, semierect, white hairs; apices trans-

versely truncate, the angles only slightly produced. Prosternum in male with depression finely, densely punctate, separated at middle by a transversely rugose, longitudinal space; in female finely, transversely rugose and indistinctly punctate. Length 9–14 mm, width 2–3.5 mm.

Type locality.—Arizona, no definite locality.

Type.—In the Horn Collection, Academy of Natural Sciences of Philadelphia.

Horn described this species from two males. The color of the pronotum is quite variable, being entirely black or red, or black with the disk reddish. Material has been examined from the following localities in Arizona: Fort Grant; Douglas; Ramsey Canyon, Huachuca Mountains; and San Bernardino Ranch, Cochise County. Schaeffer (1911) placed *Stenosphenus longicollis* Casey as a synonym of *lepidus*, but it seems to be a valid species.

Stenosphenus pruddeni Casey

Stenosphenus pruddeni Casey, Mem. Coleopt. **3**: 346–347. 1912.

Reddish brown; prothorax and legs more reddish, moderately shining. Pronotum widest behind middle; sides slightly rounded, more strongly narrowed anteriorly; surface coarsely, sparsely, irregularly punctate, sparsely clothed with rather long, semierect, whitish hairs. Elytra rather coarsely, densely, uniformly punctate, sparsely, uniformly clothed with moderately long, semierect, inconspicuous hairs; apices transversely sinuately truncate, the lateral angle spinose, sutural angle slightly produced. Prosternum feebly, transversely rugose and indistinctly punctate, but not depressed. Length 11.5 mm, width 3 mm.

Type locality.—Canyon of the Colorado, Ariz.

Type.—In the Casey Collection, United States National Museum.

Casey described this species from a single female collected at the type locality by T. Mitchell Prudden. In the Museum Collection are two additional females collected at the same locality, July 12–13, 1901, by Barber and Schwarz.

Stenosphenus arizonicus Linsley

Stenosphenus arizonicus Linsley, Ent. News **46**: 165–166. 1935.

Rufous; antennae, tibiae, and tarsi black; abdomen piceous. Pronotum strongly narrowed anteriorly, feebly rounded at sides, smooth with a few scattered fine punctures, and sparsely clothed with fine, semierect hairs. Elytra finely, uniformly punctate, sparsely clothed with semierect, pale hairs; apices separately emarginate, the angles spiniform. Prosternum broadly depressed, coarsely, cribrately punctate on each side of a median, polished elevation in the male. Female unknown. Length 12.5 mm, width 3 mm.

This species has not been seen by the writer, and has been placed in the key entirely upon the characters given in the original description.

Type locality.—Globe, Ariz.

Type.—In the California Academy of Sciences.

Linsley described this species from a single male collected at the type locality during August 1930, by D. K. Duncan.

Stenosphenus longicollis Casey

Stenosphenus longicollis Casey, Ann. New York Acad. Sci. **6**: 34–35. 1891; Mem. Coleopt. **3**: 347. 1912.

Brownish black, moderately shining; thorax and femora reddish, the pronotum slightly brownish toward sides. Pronotum widest behind middle; sides slightly rounded, more strongly narrowed anteriorly; surface indistinctly punctate toward sides, with a few moderately long, semierect, whitish hairs. Elytra rather coarsely, densely, uniformly punctate, sparsely, uniformly clothed with rather short, semierect, whitish hairs; apices separately transversely, sinuately truncate, the angles scarcely produced. Prosternum with large depression, coarsely, densely punctate, not divided at middle by a smooth, longitudinal elevation in the male. Female unknown. Length 11 mm, width 2.75 mm.

Type locality.—Texas, locality unrecorded.

Type.—In the Casey Collection, United States National Museum.

Casey described this species from a single male probably received from G. W. Dunn. In the original description he states that the prothorax is distinctly longer than wide. The prothorax of the type was found to be not distinctly longer than wide, but subequal in length and width. It seems to be a valid species, and not a synonym of *lepidus* Horn as suggested by Schaeffer (Journ. New York Ent. Soc. **19**: 124. 1911).

Stenosphenus sobrinus (Newman)

Elaphidion sobrinum Newman, Entomologist, London, **1**: 30. 1840; LeConte, Journ. Acad. Nat. Sci. Philadelphia (ser. 2) **2**: 15. 1850.
Stenosphenus sobrinus Bates, Biol. Centr.-Amer., Coleopt., **5**: 66. 1880; p. 312, 1885; Horn. Trans. Amer. Ent. Soc. **12**: 180. 1885; Leng. Ent. Amer. **2**: 194. 1887.

This species was described by Newman from North America. So far it has not been collected in the United States, but Horn (1885) states that this species, described erroneously from the United States, is abundant at San Luis Potosi, Mexico, and should not be included in our lists.

Stenosphenus pristinus Wickham

Stenosphenus pristinus Wickham, Bull. Mus. Comp. Zool. **58**: 463–464, pl. 9, fig. 2. 1914.

This fossil species was described from a specimen collected in the Miocene shales at Florissant, Colo. Type No. 2584 in the Museum of Comparative Zoology, Cambridge, Mass.

ENTOMOLOGY.—*A new African species of* Paurocephala *Crawford (Homoptera: Psyllidae: Pauropsyllinae).*[1] Louise M. Russell, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. Muesebeck.)

This paper provides a name for a psyllid collected from *Urena lobata* Linnaeus, a member of the Malvaceae now grown commercially in the Belgian Congo as a substitute for hemp. Numerous specimens were received with the request that the species be described if new. It is closely related to *Paurocephala gossypii* Russell, a pest of *Gossypium* (Malvaceae) in the Belgian Congo. Adults of the two species resemble each other closely; the nymphs differ conspicuously, however, particularly in the earlier stages. The most salient differences between the two forms are in the relative length and slenderness of the antennae of the adults, in the relative proportions of the male genitalia, in the color of adults and nymphs, in the number of sectasetae of the nymphs and the relative size of the tuberclelike prominences bearing them, and in the presence or absence of cephalothoracic tubercles in the first four nymphal stages.

Paurocephala urenae, n. sp.

With few exceptions the following description mentions only the characters of *urenae* which differ from those of *gossypii*. Other characteristics of *urenae* (those common to both species) may be found in the description[2] of *gossypii* (Proc. Ent. Soc. Washington **45**: 115–120, illus. 1943).

Adults.—Length to tip of folded wing, 1.75–2 mm; length of body as mounted on slide, 2–2.25 mm; length of forewing, 1.50–1.75 mm, width, 0.50–0.75; length of hind wing, 1.15–1.35 mm, width, 0.40–0.50; width of head, 0.50–0.55 mm; females usually larger than males; bodies slightly less stout than in *gossypii*.

Females pale yellow, males pale orange; each brownish only on eyes, distal antennal segment, tip of labium, second tarsal segment and claws of anterior leg, a small spot before end of anal vein and at end of Cu_2; also occasionally but not characteristically brownish at end of other veins and at ends of posterior five tergites of female.

Antenna about one-fifth longer than width of head, more slender, and the relative length of some segments different than in *gossypii*, as illustrated.

Genitalia of female about two-thirds length of rest of distended abdomen.

Genitalia of male with proctiger about one-fourth longer than wide and about one-tenth longer than claspers; claspers slender, their peglike teeth less stout and their sawlike teeth weaker than in *gossypii*.

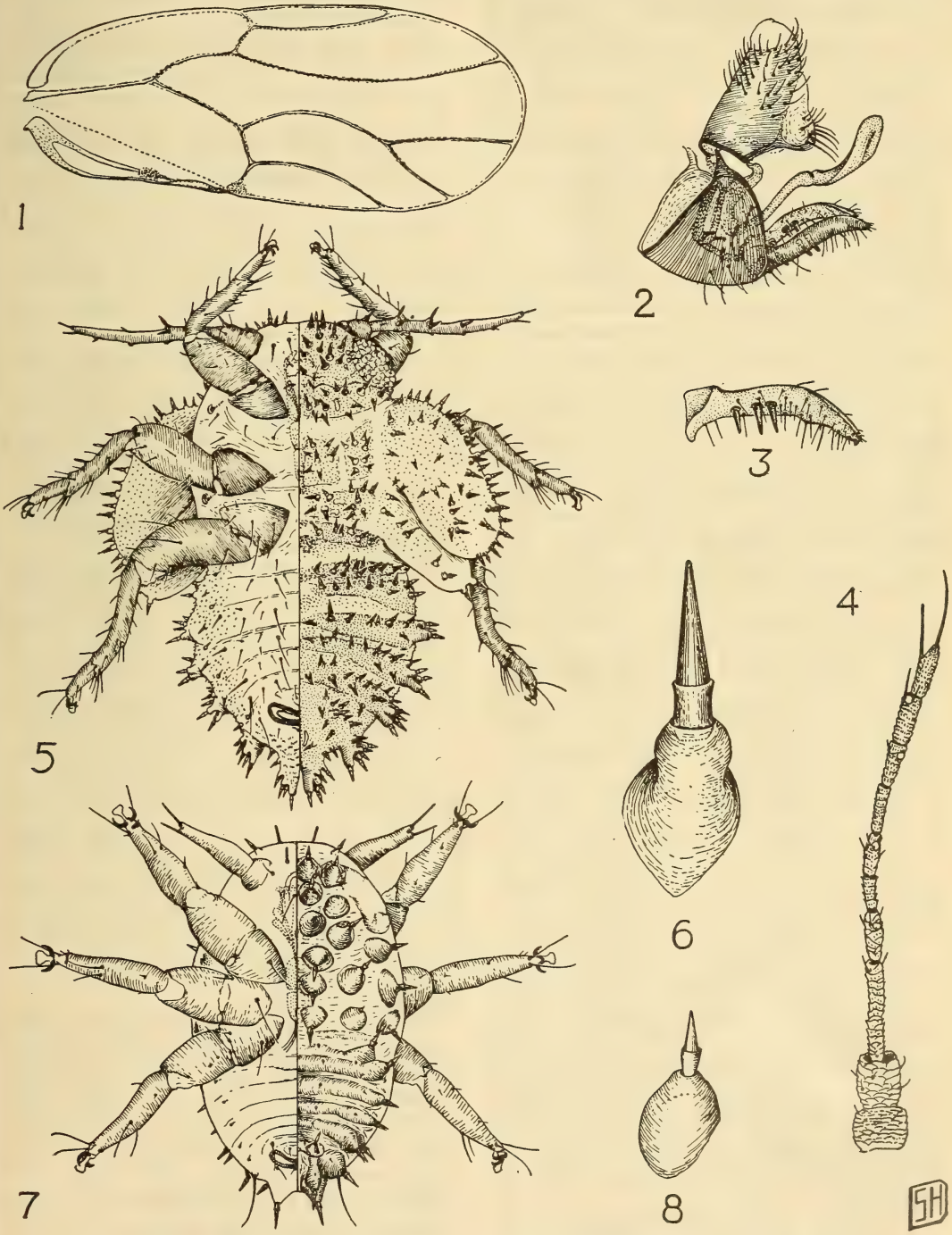
Fifth-stage nymph.—Length as mounted,

[1] Received November 23, 1945.

[2] The following additions and corrections should be inserted in the description of *gossypii:* Page 116 line 3, for "segments 1–5," read "segments 1–4"; page 117 last line and page 118 first line, for "whorls of . . . segment," read "whorls of 3 sectasetae each, 1 sectaseta just beyond middle of segment, 1 small sensorium opposite each whorl of sectasetae and opposite the single sectaseta"; page 120 line 14, for "2 sectasetae," read "1 (or 2, one small basal seta sometimes replaced by a sectaseta) sectaseta just before middle of segment, 1 small sensorium opposite it."

1.10–1.40 mm. Derm entirely whitish or pale yellowish.

Sclerotic plates less distinct, these and wing pads less sclerotized than in *gossypii;* no sclerotized spots observed along sutures. Tubercle-like prominences bearing sectasetae, slighly



FIGS. 1–8.—*Paurocephala urenae:* 1, forewing, ×40; 2, male genitalia, ×87; 3, inner surface of clasper, ×115; 4, antenna, ×115; 5, fifth-stage nymph, ×50; 6, sectaseta and prominence from head of fifth-stage nymph, ×460; 7, first-stage nymph, ×140; 8, sectaseta and prominence from head of first-stage nymph, ×460. (Drawings by Sara Hoke DeBord.)

larger than in *gossypii*, inner sectasetae no stouter than outer ones. Sectasetae of sclerotic plates and wing pads arranged as follows on each half of body: Head, 18–23; prothorax, 14–21; mesothorax, inner plate 7–11, outer plate 7–12; metathorax, 10–14; first abdominal, 6–8; second and third abdominal, each 9–12; fourth abdominal, 11–16 (2–4 on process); fifth abdominal, 12–17 (3–5 on process); sixth abdominal, 16–21 (4–6 on process); seventh abdominal 16–19 (4–6 on process); posterior abdominal 8–10 (5 on process); forewing pad, 24–32 dorsal, 23–25 marginal; hind wing pad, 6–12 dorsal, 2 marginal (at apex). A few minute short setae among (not replacing) sectasetae. No elongate slender setae dorsally near margin of head. Basal segment of antenna with 1 seta and 1 sectaseta; second segment with 3 setae, 1 sectaseta, and 1 sensorium; third segment with 2 setae or (usually) 1 seta and 1 sectaseta near base, with 2 whorls of 3 sectasetae each, 1 sectaseta just beyond middle of segment, 1 small sensorium opposite each whorl of sectasetae and opposite the single sectaseta, farther distad 1 large sensorium with a small seta, a preapical and apical large stout seta each with a minute sensorium and seta at base. One pair of sectasetae ventrally rather near margin on each of abdominal segments 3–6.

Fourth-stage nymph.—Differing from fifth stage as follows: Length, 0.75–0.90 mm. One pair of transverse sclerotic plates on mesothorax. Tuberclelike prominences bearing sectasetae, larger. Sectasetae arranged as follows on each half of body: Head, 10–12; prothorax, 9–12; mesothorax, 7–10; metathorax, 5 or 6; first abdominal, 3 or 4; second abdominal, 5 or 6; third abdominal, 6–8; fourth, fifth, and sixth abdominal, each 7–9 (2 or 3 on process); seventh abdominal, 9–12 (3 or 4 on process); posterior abdominal, 6 or 7 (3 or 4 on process); forewing pad, 9 or 10 dorsal, 10–12 marginal; hind wing pad, 4 dorsal, 2 marginal. A few short stublike setae present. A pair of rounded tubercles dorsally on posterior margin of head and a pair on prothorax just mesocaudad of cephalic pair. Antennal segment 2 without small setae, segment 3 lacking 1 whorl of sectasetae and the sensorium opposite it. Legs as in *gossypii*.

Third-stage nymph.—Differing from fourth stage as follows: Length, 0.50–0.60 mm. Sectasetae arranged as follows on each half of body: Head, 9 or 10; prothorax, 5; meso- and metathorax, each 3; first abdominal, 1; second and third abdominal, each 3 (1 on process); fourth, fifth, and sixth abdominal, each 1 median (unpaired) and 4 others (2 on process); seventh abdominal, 1 median (unpaired) and 5 others (3 on process); posterior abdominal, 4 (3 on process); forewing pad, 4 dorsal, 5 marginal; hind wing pad, 2 dorsal, 2 marginal. No stublike setae observed. Antennal segment 2 scarcely differentiated from segment 3, sectaseta replaced by a seta; segment 3 lacking whorl of sectasetae and the sensorium opposite it. Sectasetae absent from ventral surface near margin, replaced by setae. Legs, and ornamentation of derm ventrally (absent dorsally), as in *gossypii*.

Second-stage nymph.—Differing from third stage as follows: Length, 0.40–0.45 mm. Derm weakly sclerotized; sclerotic plates not defined. Cephalothoracic tubercles, and prominences bearing sectasetae, very large and conspicious. Wing pads small. Sectasetae arranged as follows on each half of body: Head, 6; prothorax, 4; mesothorax and metathorax, each 2; first abdominal, 0; second and third abdominal, each 1 (on process); fourth, fifth, and sixth abdominal, each 2 (1 on process); each of segments 2–6 with an additional pair of setal bases which usually bears a minute, or short seta but which may bear a sectaseta; seventh abdominal, 4 (3 on process); posterior abdominal, 2 (on process); forewing pad, 4; hind wing pad, 1. Antenna 2-segmented; basal segment with 2 slender setae (0 sectaseta); segment 2 with a sensorium near base (corresponding to one on second segment in later stages), without slender setae near base, without sectaseta (of third stage) and the sensorium opposite it. No setae replacing sectasetae on ventral surface near margin; other ventral setae less numerous.

First-stage nymph.—Differing from second stage as follows: Length, 0.30–0.35 mm. Cephalothoracic tubercles, and prominences bearing sectasetae, larger. Wing pads smaller. Sectasetae arranged as follows on each half of body: Head, 5 (or 4, the inner marginal one sometimes replaced by a stout seta); prothorax, 3; meso- and metathorax, each 2 (outer sectaseta of metathorax replaced by a small seta); first abdominal, 0; second through fifth abdominal, each 1 (on process); sixth ab-

dominal, 2 (on process); seventh abdominal, 2 (1 on process); posterior abdominal, 2 (on process); each wing pad, 1. Basal segment of antenna with 1 small seta. No setae on ventral surface of thorax or abdominal segments 1–6.

Egg.—Similar to egg of *gossypii*.

Type.—U.S.N.M. no. 57665.

Described from slide-mounted holotype male and allotype female, and from about 200 paratypes (dry, slide-mounted, and in liquid) collected by Mrs. D. Soyer from *Urena lobata* Linnaeus at Gandajika, Belgian Congo, May 1945, No. 443.

ZOOLOGY.—*Resuscitation of the nematode* Tylenchus polyhypnus, *n. sp., after almost 39 years' dormancy.*[1]

G. STEINER and FLORENCE E. ALBIN, Bureau of Plant Industry, Soils, and Agricultural Engineering.

In June 1945 a herbarium specimen consisting of the leaf of a rye seedling collected early in the fall of 1906 by E. S. Ayres at Edgerton, Kans., was submitted to us by Dr. Freeman Weiss, of the Division of Mycology and Disease Survey of the Bureau of Plant Industry, Soils, and Agricultural Engineering. A note on the herbarium label stated: "Rye nematode on rye. An Amerosporium also present. Disease however due to nematode."

Since Edgerton, Kans., had been mentioned by E. A. Bessey as a locality where *Ditylenchus dipsaci* (Kühn) Filipjev occurred on rye, the leaf sample submitted was expected to be infected with this species. To our surprise we failed to find the *Ditylenchus* but observed a small number of an undescribed species of *Tylenchus*, five specimens of which (two females and three larvae) revived. To our knowledge this resuscitation after almost 39 years is the longest period of dormancy as yet observed for a nematode. The previous published record of maximum length of dormancy of 27 years concerned the wheat nematode, *Anguina tritici* (Steinbuch) Filipjev. It had been established by M. Baker, a friend of M. Needham, who in 1743 discovered the nematodes in galled wheat kernels and first observed their anabiotic behavior. Needham (in *Observations sur la physique, sur l'histoire naturelle et sur les arts* 5 (3):226–228. 1775) writes as follows: "L'espèce de vie dont ces vers sont doués, et qui se conserve pendant des années dans un état parfait d'extenuation, est très singulière. M. Baker, très-connu par ses observations microscopiques, avoit encore à Londre en 1771 du bled rachitique que je lui avois donné en 1744, et qui presentait fort peu de temps auparavant les mêmes phénomènes."

According to a verbal communication made to the senior writer by Prof. Dr. Heinrich Simroth in 1913, the wheat nematode had been known to revive after 28 years' dormancy in galled wheat kept at the Zoological Institute of the University of Leipzig, Germany; the experiment after that period was unfortunately terminated through the mistake of a laboratory servant who added alcohol to the sample assuming this preservative had evaporated.

Thus resuscitation after 27 and 28 years of dormancy had been observed previously. The present observation extends the known length of possible dormancy in nematodes considerably and also establishes the occurrence of this phenomenon in the group of species united in the now revised genus *Tylenchus*. The reviviscence of mature although young females here observed deserves emphasis since in some species revival is restricted to the larval stages. The fact that even the finest morphological details could be observed in the revived specimens was particularly gratifying; in this regard special mention should be made of the cervical papillae, the phasmids, and the striation of the lateral fields, structures of such minute and fine character that their observation is considered difficult in fresh material. The species here discussed appears to be new. It resembles *Tylenchus filiformis* Bütschli, 1873. Unfortunately the status of this latter species is much confused; it appears that various authors have referred to this species several forms that would best

[1] Received December 21, 1945.

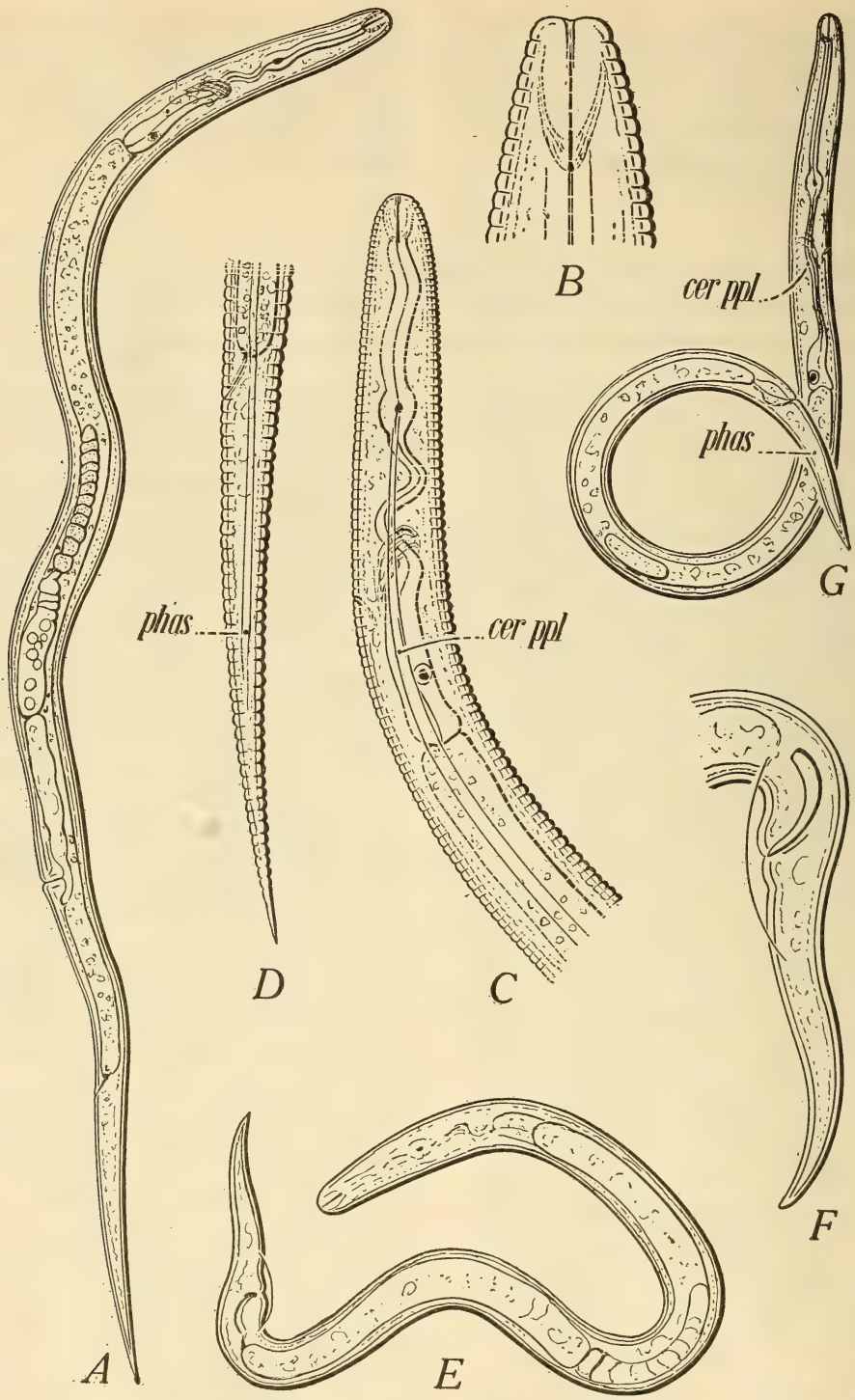


FIG. 1.—*Tylenchus polyhypnus*, n.sp.: *A*, female, × about 666; *B*, head end of female, ×2,444; *C*, anterior end (*cer ppl*, cervical papilla), ×1,000; *D*, tail end of female (*phas*, phasmid), × about 1,000; *E*, male (shrunken!), × about 666; *F*, tail end of male, × about 1,000; *G*, larva (*cer ppl*, cervical papilla; *phas*, phasmid), × about 666.

be considered distinct. It is not our intention here, however, to present a revision of these various forms.

Tylenchus polyhypnus,[2] n. sp.

Bütschli's description of *T. filiformis* refers only to the female, a single specimen of which was observed. The present new form differs from this mainly in the following diagnostic characters: (*a*) It is more slender, $\alpha = 31.5–39.0$ in the female as against 27.6 in *T. filiformis;* (*b*) the distance vulva to anus in the present form is more than half the length of the tail (3:4 and 5:6) while in *T. filiformis* it is much less (about 1:3); (*c*) the female sexual apparatus is much shorter in the present form; (*d*) the buccal stylet is extremely delicate and has rather small and obscure basal knobs, whereas the stylet in *T. filiformis* is stronger and is provided with distinct basal knobs.

Description.—(Fig. 1, A–G) *Tylenchus* of very small size; body slender, tail elongate, terminus more or less sharply pointed; head end truncate; cuticle plainly and rather broadly annulated; annules of about 1.5μ; lateral fields beginning anteriorly at about height of middle esophageal bulb, 2μ wide at a corresponding body width of 12μ bordered by longitudinal striae. Cervical papillae at about middle of terminal esophageal bulb and therefore located at some distance behind nerve ring. In female phasmid a short distance in front of middle of tail; in the male not yet located but possibly in same location as in female and therefore not forming a bursal rib. Excretory pore ventrad and slightly back of nerve ring. Head not set off, its annulation continuous with that of body. Lips apparently absent; cephalic papillae and their arrangement not yet located. Buccal stylet very delicate, in adult female 10μ long, in preadult larvae 8μ; its basal knobs small and obscure; small cheilorhabdions present. Procorpus cylindrical, not set off from middle esophageal bulb by constriction; latter bulb distinct, with small valvulae; isthmus of esophagus quite long, particularly in the larvae; terminal esophageal bulb elongate; nucleus of dorsal esophageal gland cell very prominent; nuclei of ventral gland cells not seen. Female sexual apparatus rather short, postvulvar uterus branch also short; ovary with single series of oocytes. The single male observed was a shrunken unrevived specimen; its copulatory bursa short, anteriorly beginning at level of proximal end of spicula, posteriorly extending only about length of spicula behind anus. Spicula 14μ long, curved, proximally not capitate; gubernaculum lineate, 4μ long. Tail of male apparently shorter than that of female.

Measurements.—Female: total length = 0.378–0.482 mm; $\alpha = 31.5–39$, $\beta = 5–6$, $\gamma = 4.3–5.0$, v = 59–66 per cent.

Male (shrunken): total length = 0.298 mm; $\alpha = 25$; $\beta = 5$, $\gamma = 6.8$.

Type host.—Rye (*Secale cereale* L.).

Type locality.—Edgerton, Kans.

[2] πολύς = a long time; ὕπνος = sleeping.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

ANTHROPOLOGICAL SOCIETY

The Anthropological Society of Washington at its annual meeting held January 15, 1946, elected the following officers: President, REGINA FLANNERY; Vice-President, H. W. KRIEGER; Secretary, WILLIAM N. FENTON; Treasurer, WALDO R. WEDEL; Councilors to the Board of Managers, W. M. COBB, W. H. GILBERT, JR., MARGARET LANTIS, JULIAN H. STEWARD, and G. R. WILLEY.

A report of the membership and activities of the Society since the last annual meeting follows:

Life members, 1; Active members, 66; Associate members, 30; total, 96. This represents an increase of 8 over last year.

The members elected during the year were: Active members—Miss LUCILLE E. HOYME, Dr. SOLON T. KIMBALL, LEONARD MASON, Dr. MARGARET LANTIS, Lt. (jg), JOY MAHLER,

U.S.N.R. Associate members—Dr. RUTH BENEDICT, Dr. FORREST E. CLEMENTS, Dr. MARK GRAUBARD, Miss CLAIRE HOLT, and Dr. OSCAR LEWIS.

The report of the Treasurer follows:

Funds invested in Perpetual Building Association (with interest to December 31, 1945)	$1,843.42
21 shares Washington Sanitary Improvement Co. (par value $10 per share)	210.00
2 shares Washington Sanitary Housing Co. (par value $100 per share)	200.00
U.S. Savings Bond, Series G	500.00
Cash in bank	159.62
	$2,913.04
Bills outstanding: None.	
Total as of December 31, 1944	2,915.26
Decrease	$ 2.22

The Society was host to the Society for American Archaeology at its annual meeting on May 19, 1945, at the Cosmos Club.

All regular meetings were held at the U. S. National Museum. The Society maintained a policy initiated early in the war of inviting all anthropologists resident in Washington, regardless of whether they joined the Society.

A series of discussions of *Anthropology and Contemporary Problems*, begun last year, was continued through the spring, with only one paper of a technically scientific character; and the fall meetings were devoted to open discussions of various plans affecting anthropology as a profession.

Titles of papers presented before the regular meetings of the Society were as follows:

January 16, 1945, 725th meeting, WALTER H. C. LAVES, *Anthropology in a basic social-science course.* Discussions of Anthropology and Contemporary Problems, III.

February 20, 1945, 726th meeting, RALPH LINTON, *Anthropology and cultural minorities.* Discussions of Anthropology and Contemporary Problems, IV.

March 20, 1945, 727th meeting, GEORGE F. CARTER, *New World agricultural origins.*

April 17, 1945, 728th meeting, RUTH BENEDICT, *Interim research in European personality and culture.* Discussions of Anthropology and Contemporary Problems, V.

May 17, 1945, joint meeting with the Washington Academy of Sciences, MARGARET MEAD, *Translating scientific findings into living habits.*

October 16, 1945, 730th meeting, An open discussion of a proposal for an organization of professional anthropologists.

November 20, 1945, 731st meeting, An open discussion of alternate plans for achieving professional aims in anthropology.

No meeting was held in December 1945, in view of the annual meetings of the American Anthropological Association in Philadelphia.

WILLIAM N. FENTON, *Secretary*

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VOL. 36 APRIL 15, 1946 No. 4

JOURNAL

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JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 36 APRIL 15, 1946 No. 4

National Responsibility for Research.[1] J. E. GRAF, Smithsonian Institution.

If any common ground for international thinking has emerged from the wide conflict just ended it is that the world is looking forward to a higher level of well-being for all. Leaders both in Britain and in this country have given expression to such intentions, and the hopes of most peoples are in complete agreement. As we survey the colossal destruction of the war in human, scientific, cultural, and material resources, it is clear that the attainment of these hopes is a major challenge to the human race.

Science received world-wide recognition during and in the period following the first world war. King Albert of the Belgians advanced science on a national basis by subsidizing research laboratories in universities. Industrial research grew rapidly. Even the man in the street became aware of the importance of science and invention, for articles on important scientific and technological advances appeared in the daily press. This development was stimulated by the appointment of science writers by several metropolitan newspapers. The intelligent and fair approach of these writers to their subject did much to bridge the gulf which had hitherto separated the scientific from the nonscientific.

In 1938 there was published by the National Resources Planning Board under the title *Research, a natural resource,* a thorough study of the relation of the Federal Government to research in the United States. In pointing out that research is a national resource, it directed attention to the obvious need for the development of that resource. In this admirable study an analysis was made of the amounts expended by agencies of the Federal Government and of the various fields covered. It included as well a discussion of restrictions on the use of federal funds for research, including suggestions for improvement, many of which have since received favorable mention both in England and in the Bush report in this country. The section on research in American universities and colleges pointed out the great use of these organizations in training research men and in conducting basic research, a field in which universities excel, for they are largely free from the responsibility for solving specific problems. The summary of findings and recommendations presented many suggestions which recent studies have shown to be essential to the increase of research both nationally and internationally.

The popularization of science was well under way at the time of the second world war. General public interest in science was advanced further by the Germans in their oft-repeated mention of secret weapons. During their impressive early successes, these threats reached every ear—as indeed they were planned to do. The growth of allied superiority in the development of new devices both for offense and defense was given equal publicity. A parade of new and improved weapons, culminating in the proximity fuse and the atomic bomb, left with the general public the fixed idea that success in warfare was dependent more on skilled scientists than on the millions of bayonets once boasted by a late dictator.

While the war was still in progress and the outcome by no means certain, the role of science in the postwar world was the subject of active discussion in Britain. This was a logical trend, for Britain is no stranger to state-supported science. In the several councils for agricultural, medical, and in-

[1] Address of the Retiring President of the Washington Academy of Sciences, delivered before the Academy on the evening of February 21, 1946. Received February 25, 1946.

dustrial research, in various governmental research laboratories, and in grants to universities for facilitating fundamental research, there exists a broad base for state-supported science. Beyond this, there was a steady drift toward the full utilization of science in the war effort, an urge that came from scientists and government alike. Late in 1941 a meeting of prominent scientists and representatives of the war science committees was called by officers of the Royal Society. The principal subjects for discussion were postwar problems, including those of the immediate postwar period as well as those relating to the welfare of the peoples of the Empire. Even in these preliminary discussions it was stressed that while a little coordination may be necessary to guide research into profitable paths and guard against useless duplication, science must be kept free from close supervision which could develop into regimentation.

This trend toward planning for postwar research continued in succeeding years. There were people who still insisted that the development of science should be left to individual initiative, but they were fighting a losing battle against those who said that science should be centrally organized and that research in many fields must be expanded by government action. The phenomenal success of science in warfare, which by this time was turning the tide of battle, was quoted as a sign that freedom from want could be insured only through a full utilization of science. It was pointed out that this greater, state-supported research could be directed by committees representing government, scientific societies, and research departments. The development of both pure and applied science as rapidly as possible was recommended—pure science because it is the source of ultimate technological advance, applied science because it translates the advances of pure science into security and public welfare. As pointed out in statements from Nuffield College, however, the distinction between pure and applied science can be overstressed, since both methods can be, and often are, used simultaneously in solving problems.

There were also differences of opinion regarding the relations of science to politics. While the decline of German science since the ascendancy of the Nazi party in 1933 was presented as proof that science can not under all conditions remain free of the effects of political change, Sir Henry Dale was a powerful spokesman for those who wished to keep science free of politics. "I see danger," he said, "if the name of science or the very cause of its freedom should become involved as a battle cry in a campaign on behalf of any political system, whether its opponents would describe it as revolutionary or reactionary. If science were thus to be used as a weapon of political pressure, it would be impossible to protect science itself from the pressure of sectional politics." In general the fear that a state-supported science would become involved in politics, or would lose its freedom of action, has declined in Britain. A powerful organization of scientists, and the ability to present promptly all controversial opinions to a court consisting of an informed and unprejudiced public opinion, are weapons that would work against any action, whether by government or by pressure groups, calculated to limit the freedom of science or the research upon which it is founded. Throughout the discussion of an accelerated, state-supported research, there has been ample freedom for participation by all interested persons from government, industry, and the universities. Representatives of the association of scientific workers also took an important part in all discussions. And most important to an orderly consideration of the subject, in *Nature* there was a vehicle for prompt and impartial presentation of the various opinions.

A study of the extended discussion relating to the expansion of research leaves the clear impression that Britain will develop sound plans for a wide use of science in the future, directed both to national security and the welfare of the peoples of the Empire.

The situation as to the development of science in Russia is not so completely known. The general control of research is vested in the Academy of Sciences, which directs the efforts of thousands of research

men in all quarters of the Soviet Union. Through its close relations with the universities, the Academy also has the selection of the more promising science students. With the great expansion of universities and the much larger number of students enrolled in the science departments, the research personnel of the Soviet Union is increasing on an incredible scale, probably far ahead of any other nation. The Soviet Union has shown consistent good judgment in dealing with all phases of science. Research is a respected profession with a promising career for capable students. It is publicized widely in the daily press and scientists become national figures. During the war, Russia consistently maintained research on a high plane, and refused to sacrifice scientists on the war front. Construction of laboratories and research institutes has proceeded steadily so that at the present time research facilities in the U.S.S.R. are probably second to none, either as to number or equipment. Most important to the conservation of the time of research leaders, these laboratories are well staffed with assistants. At the same time field expeditions on a lavish scale have been continued, thus adding to a knowledge of natural resources. If there is a difference in science as practiced in Russia, it is probably that science there is more clearly directed to a purpose.

Further expansion of state-supported science poses no problem for Russia. The machinery for directing additional research now exists, and laboratories and universities with adequate staffs are available. Science will certainly continue to expand, for the leaders apparently realize that an adequate standard of living involves the use of science in the development of natural resources, in the growth of industry and commerce, and in further research in matters relating especially to health, food, and housing.

Elsewhere in Europe there are numerous signs that a centralized and expanded science will develop in the near future. Scientists met the most discouraging adversity in the war years with courage and devotion and kept alive a distinguished research tradition. With the record of those war years, it requires little imagination to anticipate a steady and strong growth, possibly even a great increase in research throughout Europe.

With science taking giant strides in other countries, the question might well be asked, "What of America?" There is need now to take stock of our place in world science, for isolation in science is even less possible than is political isolation. As we review our own place in science, there is room both for pride and humility. In the war we gave a crushing demonstration of the scientific and technological abilities and the industrial might of the United States. In accomplishing this miracle, however, we plundered our natural resources and we raided the ranks of our younger scientists. The net result is that we face a postwar world with depleted reserves both as to scientific personnel and natural resources. The dearth of trained scientists is doubly serious, since the shortage touches teachers as well as research workers. Of these the teacher shortage may be the most serious for until the universities and technical colleges are staffed effectively we can never hope to make up the present deficit in scientists. When we consider the planned increase in science in other countries, it is obvious that the elimination of our present deficit in research personnel is only a first step toward our goal.

Leading scientists are agreed that our country must embark on an enlarged program for scientific research and development. They further agree that to accomplish this object and insure the security of the nation and the welfare of its citizens, federally sponsored science is necessary. There is disagreement as to details touching the disciplines involved, to the types of institutions which should participate, and to the nature of the administration required. It seems certain that legislation dealing at least with some of the needs of research will be enacted.

The greatest source of danger to a plan for subsidized research is that the country as a whole does not truly appreciate the importance of this subject. With doubtful or wavering public support, a period of rigid economy might well cripple or completely stop such a program. This is a real danger,

for science has always been the first casualty in periods of retrenchment. The continuity of such a program can be assured only when the people of this country know that it is certain to win over a long period—even more, when they realize that without a strong, efficiently administered program of research, we, as a nation, shall be competing at a great disadvantage in a new world. We shall be competing at a disadvantage not only as to national security, and national welfare, but also in maintaining the world leadership we won in the period ending with the close of the war. Public support must be based on public appreciation of these facts, and only when this occurs will a program for increasing scientific investigation receive active and continuing support. The public should be treated with frankness; it should be informed that research is a gamble both as to the specific results obtained and the time involved. This is especially true in the case of basic research, the type most urgently in need of stimulation.

Is the world preparing to turn to competition in science, and what has happened to place science in the forefront of international affairs? Science and invention together had made an impressive record in the 40 years antedating the war. These developments touched the daily lives of millions. An enumeration of a few of the major industries will illustrate the great social implications of expanding science. In 1900 there were few telephones. The major growth of this huge utility falls within the forty years under consideration. Within this same period there came the automobile, airplane, motion pictures, rayon, and the radio. These inventions became the bases for giant industries, giving employment to millions, paying huge taxes, and providing conveniences that, while now commonplace, have had social influences too great to assess. Most of us knew of these achievements, but it took the greatest war in history to crystallize this knowledge into a full appreciation of science.

We shall consider science as related to national security only long enough to admit that we must have adequate research on weapons related both to offense and defense. To plan otherwise in our present confused world would be unthinkable. Preparedness, more than ever before, is the price of liberty. We may well remind ourselves that national security, for the long pull, should be based on something more lasting, and less exhausting, than more and bigger ships, planes, bombs, and guns. It would be well to be warned by the numerous examples in history that give weight to the words of Nietzsche, "Simply by being compelled to keep constantly on his guard, a man may grow so weak as to be unable any longer to defend himself." In planning means of avoiding future wars we must remember that in human contacts, whether on individual or national levels, fear is a poor substitute for understanding and reason.

Our principal consideration will be given to research aimed at improving the welfare of our people. This includes the types of research concerned with the development of the country's resources, its agriculture, industry, and commerce. As a nation can be only as strong as its individual citizens, the research program must be directed also toward the health of individuals, their food, shelter, and clothing. Since our goal is the accumulation of new knowledge on a wide front, all promising sources of information should be enlisted. It is not a small program, for its orderly development means the utilization of both basic and applied research in many disciplines, including not only those of interest and utility to man, but also those dealing with man himself and his relations to other men. It means the cooperation of institutions of many types, the universities to train scientists, and to conduct basic research; private institutions to undertake investigations in all categories and in all fields; Federal agencies to conduct both basic and applied research of wide scope; and finally, participation by the magnificent research services of American industry. The task ahead calls for the greatest wisdom that can be brought to bear upon it. It is a challenge to the government and to the scientist alike. There must be cooperation between agencies, for from these contacts there will arise the encouragement and inspiration so necessary to

creative achievement. Perhaps I should say cooperation and coordination; but since the latter term is susceptible of several definitions, especially as to degree, it should be used with care. A reasonable amount of coordination is required to make certain that the new program of research will become a useful and effective portion of the nation's total research. Care must be taken, however, to see that this program does not become a super science department with power over all national research. In the interest of good administration, the authority to direct and the responsibility for results must be bracketed together. Beyond this, there is required the application of a few general principles that have been demonstrated to be necessary to any efficient conduct of research. Science can not be regimented. At most it can be directed only along very broad lines, for who can declare in advance what is of great and what of little importance? It is obvious that specific direction could never have developed a Pasteur or a Kekulé. Their contributions to science arose from their own inquiring minds, from a great body of knowledge they had accumulated, and from disciplined imaginations. Under close supervision they would have been superior investigators, but they would probably be forgotten now. The degree of supervision and planning must be determined by a body of men who understand science and appreciate the difficulties of research, men who are capable of judging progress and the ability of individuals without looking over a worker's shoulder or, even worse, requiring multiple reports. Accomplishment has been observed over the centuries, and, while it is susceptible of broad variations, its recognition by experts does not require a lifetime. The selection of wise administrators of research, the determination of when and how to provide support, and how much to provide will always hold the key to success in any expansion of the research of the nation. Funds can be provided by law, projects can be assigned, but this alone can not assure maximum results, for organization can not do what only the genius of individuals can accomplish. The statement of Plato, that "under the influence either of poverty or of wealth, workmen and their work are equally liable to degenerate," is as true now as it was in his day. We must have understanding of science rather than science worship, and above all we must realize that science is a working tool, a means to an end. In stressing the use of research for social ends we are only restating the ideal of Benjamin Franklin, who made that objective a basic purpose of the American Philosophical Society.

The Federal Government is now engaged in research on many matters that concern both the individual and the nation as a whole. The development of national resources and their wise conservation constitute a field in which the government should lead and cooperate with all others engaged in similar research. This relates to forestry, geology, and agriculture in all phases, to mention a few of those close to national well-being.

Agriculture has always been closely related to human progress and still plays a dominant role in man's health, food, and clothing. With industry it will to a great extent determine his standard of living. Though plenty and peace may not be invariable companions, when the life of individuals is not a hopeless struggle for existence class strife within a nation and hostilities between nations certainly tend to disappear. A greater knowledge of agriculture will bring us nearer to this objective. There is still much to be learned about the land and its maintenance, about crops and the economics of farming. We must learn well and rapidly, for our new lands are shrinking. Our last large frontier is in the Arctic, and we are far from a knowledge of how to utilize it. In these basic matters that affect all citizens the government should be the leader and coordinator of research, with responsibility for its effectiveness and its extent.

The role of research in solving many of the problems of nations seems to be well established, and the welfare of a nation in this industrial age depends very largely on the continuing extension of the horizons of knowledge and the practical application of that added knowledge. The obvious question relates to how this may be brought

about in this country without incurring excessive expenditures and thus jeopardizing the success of the entire program. It seems clear that the project is of such scope and size that it must be administered and subsidized at the national level. The direction of such a complex program must be in the hands of experienced men who understand science and appreciate its social implications. Wide representation on such a group is necessary from all the agencies contributing in an important measure to the success of the program. This would include the Federal service, universities, private nonprofit research organizations, and industry. This group provided with advice from committees representing the various disciplines and with administrators as required would be fully capable of selecting broad fields for research, of selecting individuals or agencies to conduct research, and of determining the amount and nature of support required.

The types of national science foundations thus far suggested are of less importance than the abilities of the men appointed to the foundation. If the leaders are chosen for their qualifications, their distinction, and their ability and desire to serve, the administration is in safe hands. The tendency toward honorary or part-time appointment can be overdone. The program is too large, too complex, and much too important to be administered as an avocation.

It is not to be expected that such an organization could operate at full speed immediately for it must learn as it proceeds. It could, however, undertake several objectives with full knowledge that it is on the right track. One of these relates to providing additional research men, in part to make up the acute shortage which developed during the war, and partly to assure a supply of well-equipped men to carry forward the increased research this country must undertake.

One of the first steps to be taken in increasing trained research personnel is to eliminate much of the wastage of promising students who for financial reasons fall by the wayside before completing their academic training. The salvage of superior students from this group is an efficient and economical plan, for they have completed part of their training and their capabilities are already known. Scholarships should be awarded only to those who can profit from university training, and the leaders among the students should be educated just so far as this education is of use to them and to society. Those chosen to seek further knowledge should meet the high qualifications established by James B. Conant, "For the scholar, the seeker after truth, whether he be mathematician, archeologist, scientist, philosopher, poet, or theologian, must come into the court of public opinion not only with clean hands but with a consecrated heart. He must have integrity of purpose, a disciplined imagination, and the power of critical analysis of both the problem at hand and his own contributions. In addition, he must have high standards of performance as to the technical aspects of his task." In granting scholarships it would seem wise to examine present organizations experienced in this field to learn whether the existing machinery or methods for this purpose are capable of administering a larger government-sponsored scholarship program. It would be wasteful to ignore demonstrated accomplishment in this specialized field.

In training young scientists it must be borne in mind that quantity can never take the place of quality. New ideas, or new applications of old ideas, do not arise from oceans of minds. They come from a few superior minds in which inquiry, knowledge, and imagination are compounded in favorable proportions. Linnaeus long ago noted that encouragement should be given to clever students, "for the great discoverers are among them, as comets among the stars." The effectiveness of a training program depends almost entirely on the ability of the teachers, as has been so often demonstrated where a single preeminent professor has carried his department to first rank within the nation. If outstanding students are to be aided in obtaining the training necessary to speed research at full efficiency, it is equally important to relieve the outstanding teachers of the extraneous duties which reduce their use as teachers. It may even be said to be more important, for a single teacher may train and inspire many

discoverers. In any training program it is thus necessary to seek both students and teachers. Once these are brought together in an environment favorable to science, it will be demonstrated that huge numbers of investigators are not required to keep our country among the world leaders in science.

Under the scholarship program the nation will become deeply involved in educational matters, and it can not escape a direct interest in the quality of training facilities. During the war period, colleges and universities gave close study to their curricula with the idea of making improvements where changes were indicated. One change suggested was a broader base in training in the first college years. The report of the president of Pomona College to the alumni illustrates how one college has met the changing trend: "The new curriculum is dominated by the philosophy that in the first two years the student should acquire certain fundamental skills, appreciations, and bodies of knowledge." This is a definite change in the right direction and agrees closely with British statements on the subject. Broad training in fundamentals will provide the student with the confidence and the working tools so necessary to systematic solution of problems.

Another urgent field for expanding our educational facilities is the training of specialists in foreign areas. The need for this has been expressed very well in the constitution of the United Nations Educational, Scientific, and Cultural Organization: "Ignorance of each other's ways and lives has been a common cause, throughout the history of mankind, of that suspicion and mistrust between the peoples of the world through which their differences have all too often broken into war." The war showed us that area experts in the United States were almost nonexistent. Through the cooperation of the universities and colleges great strides were made to meet the need for such knowledge. Training in this field must be continued since the necessity for such experts will not be less with the coming of peace. We must learn more of other peoples and their problems, for whether we like it or not we are now neighbor to all peoples of the world.

Interdisciplinary training should also be stressed. A research man should have knowledge of several disciplines beyond the specific knowledge of the division or subdivision of his own field of science. With this added equipment he has a clearer understanding of his problems and possesses abilities to use these related disciplines for their solution. He is not only a better research man on his own, but with this wider appreciation of the utility of other disciplines he is more valuable as part of a research team. War research demonstrated that scientists often received their most useful assistance from coworkers, who brought to the solution of problems viewpoints and methods from widely different types of work.

The continuing success of the plan to stimulate research will depend to a large extent on the understanding and intelligence used in the administration of the program. Its first concern is to outline policy, to determine what funds are to be procured, and to learn how to obtain the maximum of results from the funds at hand. The latter consideration includes a decision as to the approximate proportion of the funds to be expended for security research and how and where it will be used. The remaining portion for welfare research must be further divided between scholarships and basic and applied research. As to agencies, it must be divided among university laboratories and classrooms, private, nonprofit research institutions, government research laboratories, whether Federal or state, and laboratories for the solution of industrial problems. The selection of laboratories and men, the terms under which funds will be available, and the approval of projects will all have much to do with the degree of success of the undertaking. Administration of the program will require the continuing study and advice of many scientists from all disciplines. Projects may or may not succeed, but they should have an honest chance by being placed in the friendly surroundings of skilled investigators and well-equipped laboratories. Beyond this each project should have a fair test as to time. Year to year allotments with no assurance against reduction or termination are not likely to attract the best minds. Utilization

of our leading scientists for stop-gap experimentation would be unfair both to the man and to the nation. No practice should be adopted as adequate until its soundness has been demonstrated. One example will suffice. We speak of basic and applied research as two separate fields, which must be kept distinct. Some believe that the basic research workers would be unable to apply their findings to practical use and that applied research workers would be of little use for fundamental research. This may hold for a small number of scientists, but a large number of men have shown by their work during the war that the same general qualities are required for superior research of either type. Basic and applied research are now used together by the London, Midland, & Scottish Railroad under a plan by which research men from the railroad and its cooperating universities are exchanged for temporary periods. From preliminary observations it seems that both basic and applied research will profit from this arrangement. It is a further step in breaking down the cell walls that have, in varying degrees, insulated one worker and one problem from another.

Those who will be responsible for the administration of public sponsored research must expect criticism, for they are using funds in which every one has vested rights. Public support is absolutely essential to the continuing success of an accelerated program; and this support to be lasting must be based on an understanding of the aims of the program and an appreciation of what science has done and can do again. There should be full publicity on all phases of the operation of the program. It must be necessary not only to be independent of the influence of pressure groups but also to be able to prove that independence. Though wartime science went from one triumph to another, it must be remembered that peacetime research will be measured by different criteria. During the war the cooperation of research men was a patriotic duty, and the cost of projects was entirely secondary to speed and to success in solving problems. In times of peace the cost of research programs will become a matter of major importance and one for annual discussion.

The results of research touching individual or national well-being should be given the widest distribution. This should be the standard method not only of diffusing useful knowledge but also of reporting progress. Used intelligently, it will make unnecessary the collection of multiple reports, questionnaires, form, and records, which at best accomplish little more than delay the work and drive out those investigators who prefer research to the piecemeal discussion of it. Publication of results should be prompt and full, and adequate distribution should be made nationally and internationally. This will serve not only to speed research but also to prevent needless duplication of effort.

Whether publication should be undertaken in more than one language is problematical. I should incline to advocate that each nation publish in its own language and leave to an international catalogue and abstracting service the task of furnishing abstracts and serving as a clearing house for providing translations in such languages as may be requested. This would be no great change from the International Catalogue of Scientific Literature, which after years of effective service to science suffered so grievously from the first world war that it never recovered. If the nations truly wish to cooperate, let them resurrect this useful service with such changes as the needs of the present day may require.

Although our discussion has been concerned largely with the national aspects of such a research program, there are many who will regard it as only one part of a larger problem. The real objective of this undertaking for the increased use of science depends largely on who happens to be explaining its purpose. To one, science may insure national security; to another, it may mean the economic welfare of the nation; while a third might look at the world and see international cooperation and understanding and enduring peace. Science utilized more widely can raise the standard of living in America, it can provide jobs, it can turn the wheels of industry and fill ships with exports. It can increase the comforts of individuals; and, as far as weapons may be concerned, it will certainly increase the

security of our nation. All this, however, is the answer to only a part of the question as it affects Americans. Our welfare over any long period is related to the welfare of other peoples, for now as never before poverty and misery in one part of the world affect the prosperity and well-being in all parts of the world. Thus our standard of living can not be completely and permanently independent of that of other peoples.

As a preliminary to improving the economic status of peoples, it is urgent to speed the work of recovery in all countries. This heavy task calls for international cooperation in all fields of science. Obviously those nations that have suffered the least must assume the leadership in this program of restoration. The question as to where this cooperation should start or what it should undertake is one of some magnitude. The most urgent need is in those countries that were overrun by the Axis, in which science was destroyed in part and scattered. The first step is to help each nation to help itself by organizing exchanges of current literature, abstracts, and translations as rapidly as possible and to bring victims of a scientific blackout up to date on recent world research. Restoration of the scientific literature in war-area libraries is a large task, but an early beginning should be made. Contacts between workers on similar problems should be established and assistance given, if only advisory, on research materials, equipment, and other facilities. International contacts and meetings concerned with science should be expedited and the exchange of students and teachers promoted. The preliminary operations in these fields are largely multilateral in nature and they should fall within the scope of international organizations. Of these the one covering the broadest field is the newly formed UNESCO; and there are others of lesser scope, some of which are ready for operation. It is too early to make promises as to the activities of UNESCO, for it is still in the preliminary stage of organization. Specific programs have been proposed covering such subjects as the social problems of housing, language teaching, and surveys for rehabilitation of the educational systems in devastated countries. It will undoubtedly serve on a world-wide basis to promote the free flow of information, both cultural and scientific, and to encourage the exchange of students, teachers, scientists, and artists. It will be a general source of information to facilitate giving to nations the educational, scientific, and cultural aids lost in the war. In undertaking these activities, however, the projected aid is on an advisory rather than on an active participating level.

The more active operating programs in international cooperation will include those on a bilateral basis. Such projects, arranged through the Committee for Scientific and Cultural Cooperation, are already in operation in many places in this hemisphere. Projects of this type, now active, include such diverse fields as agriculture, anthropology, geology, tidal studies, vital statistics, and meteorology. There is included also cultural cooperation in many fields of the humanities and the exchange of personnel, including scientists. These projects, which must be of value to both participants, are operated on the level of the people, and active participation by both countries is required. The objective of the program is to further understanding between the nations and peoples of this hemisphere, to advance their interests, and to maintain peace. That the plan is successful in advancing international relations has been demonstrated repeatedly. Authorization for the extension of this program to other parts of the globe is now before Congress. Cooperation in science on a world-wide scale, in improving economic conditions within nations, can contribute much toward removing a fertile and continuing cause of wars. We must remember that any discussion relating to the welfare of peoples can not avoid consideration of ways and means for preventing wars, which cause losses in human and material resources, beyond appraisal. The last war cost this country alone over a million casualties and 354 billions of dollars. These partial costs show clearly the futility of planning a comfortable standard of living, if wars, on the modern scale, are permitted to recur at intervals.

The question has been asked as to whether science is not given an undue por-

tion of the projected program and whether the well-being of peoples would not be advanced further by including the humanities. These have always been international in character and thus furnish a meeting ground on which races, creeds, and nations may find common appreciation and understanding. The humanities play an important part in the progress of mankind, and obviously the advancement of human welfare and peace must include the humanities in ever-increasing amounts. One answer to this question is that a program including the humanities is now operating under the guidance of our State Department and it will expand as it receives further support from the United Nations Organization and from other programs of international scope. It is a separate program and should remain so, both as to direction and support. Perhaps the principal answer to the question is that survival and recovery are the immediate needs, and science has demonstrated its ability to function in emergencies. Science is ready to go ahead now and it has world-wide support. In addition to meeting immediate needs, science can do much to sponsor international good-will for it too is truly international in character. Science has an important role in pointing the way to the recovery, well-being, and peace of the world; but it will make its greatest contribution to human welfare when it realizes the necessity for pooling its efforts with those from other sources of assistance. Thus, whether we consider our problem from the national or world-wide viewpoint, all science might well adopt the ideal to which Hugh Taylor, in speaking for the physical sciences, gave such eloquent expression: "In the free world to which we still dare to look forward, with the soldiers and statesmen, artists, humanists, philosophers and priests, we must integrate our scientific skills with the social and spiritual aspects of human life and nature. That goal attained, we shall not lack either direction or support."

ETHNOLOGY.—*An Iroquois Condolence Council for installing Cayuga chiefs in 1945.*[1]

WILLIAM N. FENTON, Bureau of American Ethnology.

Three of us white people stood shivering in the November afternoon on the common at Lower Cayuga Longhouse (Fig. 2). Robert and Marcelle Hatt had parked the Cranbrook Institute Buick alongside a row of Indian cars, and I had backed the Library of Congress Recording Laboratory sound truck abreast of the others and dismounted without locking the doors, remarking to Joe Williams, a Seneca from Allegheny, that my cameras would be safe since there were no other white people around. Inside the longhouse the Cayuga and Oneida chiefs were still rehearsing the Six Songs of Farewell to the Dead Chief.

Smoke of the cooking, intended for the chimney, drifted out the door of the cookhouse just east of the longhouse. One of the two male cooks for the new chiefs, Patterson Davis (C.),[2] ladled meat, chunks of boiled beef, out of a great iron cauldron into a wooden trencher. This was part of a quarter of beef that we had procured in Caledonia the day before of William Smith, butcher to the Six Nations. In olden times eight men were appointed to procure venison for the feast; they went out all abreast driving the game until eight deer fell. Nor was there any corn bread, hulled white corn soup being the only aboriginal dish. I re-

[1] A lecture on "The Six Nations of Canada" given before the Royal Canadian Institute, Toronto, January 12, 1946. Published by permission of the Secretary, Smithsonian Institution. Received February 7, 1946.

Field work for this paper derived support in 1941 and 1943 from the American Council of Learned Societies, in 1945 from the Viking Fund, Inc., Cranbrook Institute of Science, the Library of Congress, and the Smithsonian Institution. In the narration the writer has checked his own observations made on November 20, 1945, with the explanations of Deputy Chief Howard Skye, interpreter, which form the warp of the fabric, and into these he has woven speeches taken from a long Onondaga text describing the same ceremony which Chief John A. Gibson dictated to Dr. A. A. Goldenweiser in 1912 as the final fifth of a 525-page account of the founding of the League, that much having been translated from Onondaga to English by the late Simeon Gibson and the writer in 1943.

[2] C., Cayuga; M., Mohawk; Oe., Oneida; Oa., Onondaga; S., Seneca.

marked to Mrs. Silversmith who oversaw the preparations for the feast that women are customarily feast cooks at Tonawanda and Allegheny among the Senecas where men wait on the women, but she confirmed what we saw at Six Nations on Grand River—men usually do the heavy cooking for longhouse feasts. Evidently the Canadian Iroquois matrons hold their clansmen in firmer control than their Seneca sisters on the American side.

But both sexes fulfill the role of "hanging the kettles for the chief" (honwanajiahaá-nink ne' hoyaáneh). Each matron enlists a man and a woman. Mrs. Bomberry had two cooks: Patterson Davis, an official of the longhouse, and his half-brother Freeman ("Spike") Gibson, one of the two male leaders of Seneca Longhouse. Bob Bill, Howard Skye, and his sister Mrs. Silversmith served Jemima Gibson. All cooks, being Cayugas, belonged to the proper side.

A car lurched through the gate and chugged up the common. It disgorged a stout Cayuga chief, Hagya''trone' (Alex Nanticoke), and a younger deputy, S'oheés (Howard Skye). They were returning from Onondaga Longhouse, some two miles west, and they hustled inside to report. About noon the Three Brothers side (Mohawk-Onondaga-Seneca) had dispatched a scout (haihwakdon''na') to find out the state of preparations at the Four Brothers (Oneida-Cayuga-Tuscarora-Tutelo) fire. He went first to Lower Cayuga Longhouse, but finding no one there he returned partway to the matron's fire where the cooks were eating. Jemima Gibson who sponsored the ceremony and her maternal relatives and in-laws had set a dinner for the Cayuga chiefs and the cooks whom she had enlisted to work at the longhouse. The Onondaga runner, who drove a Ford, was told that the Four Brothers would send a messenger when ready. On returning to the longhouse from dinner, Desga'he' (Chief Alex General) arranged to send a runner to Onondaga. Howard Skye was appointed, and Hagya''-trone' drove him. Arriving at Onondaga Longhouse, the Cayuga messenger found the chiefs inside rehearsing the Requickening Address. They stopped on seeing the messenger who said, "I am bearing a message of the Four Brothers who sent me to say, 'Now preparations have been completed.' So that is the sum of my message."

With the return of the Cayuga messenger, everyone knew that the Three Brothers had taken up the path and would arrive momentarily. Warriors were detailed to kindle a small fire near the gate. They cleared away the leaves and dry weeds just east of the path leading from the road to the common, where a cook carried embers from the main fire. They build the wood's-edge fire as soon as they hear the singer chanting the Hai Hai on the path, recounting the Roll of the Founders of the League, while the procession of Condoling chiefs nears the fire of the grieving tribes.

About 3 o'clock "Keya'dawennn . . . (My nephews," the prolonged cry of the crier who marches beside the singer, floated over the elm and shagbark hickory trees to reach us before we heard the voice of the Hai Hai singer. The cry meant that the singer had just completed the roster of a committee of founders representing one of the Five Nations. The shout of the "uncles" quavered on the cold wind. I shivered, transported three centuries to the reedy shores of Cayuga Lake, wondering how that cry must have sounded coming over the forest from Onondaga near modern Syracuse. The clear voice of the *Haii Haii* next reached us. The singer was Roy Buck, a warrior in his thirties, whom the chiefs of Three Brothers side were grooming for this role at the rehearsals.

The procession passed Peter Atkins's at Six Nations Corners and neared the gate. In advance came Sam Silversmith (Oa.) and Bill Henry (M.) at the head of a double column. Next came the singer and the crier. Then walked Onondaga chiefs Gowena'-sen'donh (Peter Buck) and Tadodáaho' (Joseph Logan), followed by the rest of the chiefs; most of them carried canes, of which one was carved with ball and socket. The scouts also carried sticks. (Fig. 3.)

Anciently the two warriors, who guard the singer (denhunwadiya'dadún''), probably ranged far ahead as scouts. It was Howard Skye's opinion that in olden times, at the founding of the League, warriors of enemy nations lurked in the forest. Evi-

dently the order of march did not follow the roll call of nations—from Mohawk to Seneca—and it is not certain that this order was customary; at any rate there were two warriors, a singer and crier, the chiefs and deputies, such as were in attendance, in double column. One wonders that the systematic Iroquois had overlooked the chance to regiment the line of march.

WELCOME AT THE WOOD'S EDGE

The Oneida and Cayuga chiefs, their deputies, matrons, warriors, and the following public came down the common and

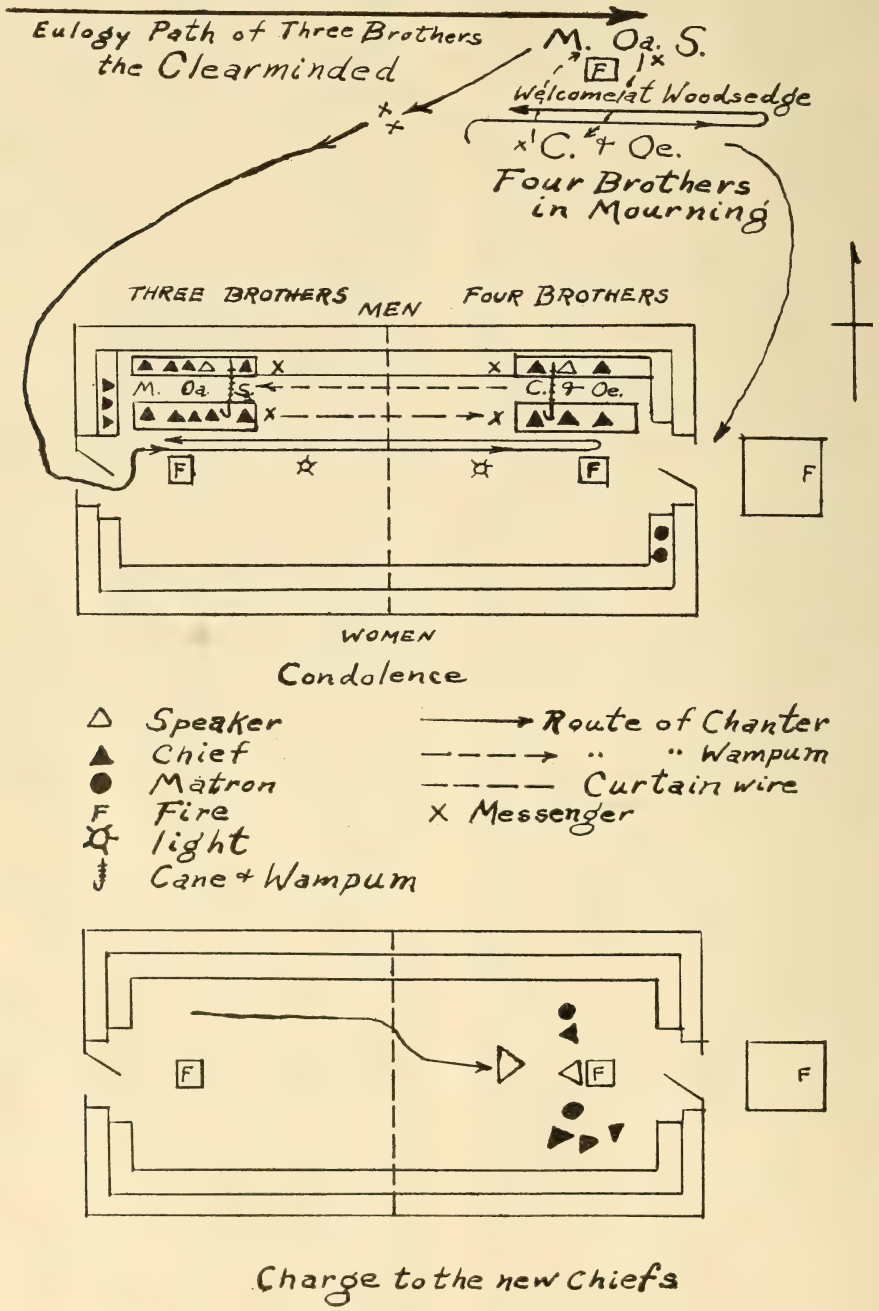


FIG. 1.—Diagram of the Condolence rite and the Charge to the new chiefs.

ranked themselves in this order facing the fire, the road, and the oncoming procession. The procession of visiting chiefs, followed by their public—a motley crowd afoot and in automobiles—turned in the gate and took up similar positions across the fire but toward the road. The two guardians of the singer ranged out to flank the front line of chiefs. On reaching the fire the singer stopped, and Sai''go·na (Big Knife), David Thomas (Oa.), took a central position next to Chief Logan as speaker for the Three Brothers. Deputies formed the second line, matrons and the public ranged behind. At the wood's-edge fire was enacted a scene worth filming (Fig. 1): the two crowds divided by the fire and five yards of common; dead chicory and frosted asters; smoke arising through bony limbs of shagbark hickories above the Three Brothers; cars, women, babies, men in finely tailored suits and overcoats, some in overalls, but none in native costume. One of the scouts glanced apprehensively in our direction where we stood apart east of the fire so as to review equally both moieties. But we held to our pledge not to take pictures, and the scouts relaxed when they saw we meant it.

A representative of the Four Brothers side, a tall spare figure whom we recognized as Alex General, who bears the title Desga'he', belonging to the Upper Cayuga band, stood to the fore near the fire leaning on his cane and waiting for the Three Brothers to come up and form ranks across the fire. Now he took up his cane and paced slowly to and fro chanting the measured phrases of welcome. This act they call Deyothnyongwaarakte', "Beside the thorny brush," or "At the Wood's Edge." The words in Mohawk are as printed in Horatio Hale's *Iroquois book of rites* (1883), but in performance the phrasing is entirely different, as I discovered on recording the chant. In chanting, sentences are not differentiated and it takes all one's breath to express one word:

Onenh wenisseraa'···de'—now today
wagadyerengoo'···wa—was I greatly startled
deshawennawe'rade'—by your voice coming
ne' Kendeyohhoo'···don'—to this clearing (opening).

One is reminded of high Anglican mass. Desga'he' had typed out the words from an old penciled script by John Doctor, and there is no telling whether Doctor had it from Hale or from the same source. But Desgáhe' managed without the book until toward the end, there being not quite a hundred "words" (phrases) to remember. Thus for centuries the grieving tribes had greeted the condolers, "Great thanks that you have passed safely diverse obstacles and dangers that beset your journey [except for 200 yards of clay, a gravel road connects Onondaga and Lower Cayuga Longhouses]; journeying you passed places where the Founders on whom their faith rested used to meet." The Cayugas speaking say, "My Father's Clansmen, how can your minds be at ease when you kept seeing the traces of our forefathers, and barely persceptible is the smoke still rising at the places where they used to smoke in council, they who sustained our minds, and you saw on your journey the traces of their labors? How then can your minds be at ease, when from your eyes tear drops hang repeatedly, My Uncles? Thanks greatly that you have reached here safely. Now we both have come together (with tears in our eyes) and sat down (across the fire) [but they now stand]."

The chanter goes on to conjecture the awful calamity of a death on the trail, or some similar disaster to one of the chiefs. But the founders ordained that a fire be made at the wood's edge, where they shall condole each other briefly; they will employ but three words, reserving the principal matters for inside the house where the main business is transacted; then shall they rub down each other's bodies; there shall they be taken by the arm and seated on the main bench.

A list of town names founded by several maternal lineages concludes the chant. First come settlements of the Wolf clan, the two clans of the Turtle who are offspring, and the Bear clan who are Brothers. Some place names are now obscure; others resemble town names of seventeenth-century Iroquoia. These were the clans of ancient times (belonging to the Mohawk and the Oneida).

THREE RARE WORDS OF REQUICKENING[3]

The first chant ended abruptly. Once more Desga'he' stood in the central position before the fire resting on his cane. Hagya'-trone', at his elbow, produced the first three strings of Requickening, which are of variegated purple and white wampum beads. Originally a horizontal pole resting in forks of two uprights held the wampum strings at the fire beside the trail. But today Chief Alex Nanticoke, who keeps the wampums for the Cayugas, let the three short strings hang from his hand. Nor had the Condoling phratry set up cross poles for receiving the strings. It was a surprise to me to see the Mourning chiefs send over the first three strings to the Clear-minded, because Hewitt (1944, p. 70) assigned this role to the latter; but it was to clarify such issues that I had waited ten years and come to Canada to witness the ceremony.

We did not record Chief General's words in Cayuga because Hewitt and Goldenweiser had them from earlier informants. With the first string the speaker for the mourners acknowledges the Creator's part in making the day and causing the number of persons, who have come on the road with tears in their eyes, to reach the appointed place where the fire rests at the wood's side. The Four Brothers think it wonderful. Now he wipes away their tears with the white fawn skin of pity to enable them to look around with clear eyes and notice passing persons. Having calmed them, his messenger (Howard Skye) took the first string of wampum over the fire to the Three Brothers where it was received by Chief Logan. Similarly, the speaker proceeded to remove obstructions from the ears (second string) and throat (third string) of the Clear-minded.

Now enabled to see, to hear, and to breathe freely, the speaker for the Three Brothers replies to the mourners. The Clear-minded confirm what the Lower folk (Cayugas live down the Grand River) have done, giving them to understand that they approve of the number of matters so far uttered. "Further," say the Three Brothers, "what befell you is not a one-sided affair [it affects both moieties], which is the purpose for the Three Brothers' coming. What a calamity has befallen the Four Brothers. Yea, a seat is vacant in the place where you all customarily assembled. Now a man has died toward whom the people used to look and direct their minds. Now the bench is vacant. And consequently you the Four Brothers are in the midst of great tears."

Now the Three Brothers customarily wipe away the tears to enable the Four Brothers to see what transpires on earth, etc. Here a deputy for the Condolers carried the first string back over the fire where it was grasped by the Cayuga wampum keeper (since both sides have their own sets of Requickening strings, the strings go back in succession to the owners).

And so the speaker for the Three Brothers, the Clear-minded, proceeded to open the ears and remove the obstructions from the throat of the grieving Four Brothers, sending back the two remaining strings, one at a time, by his deputy as he completed each word.

Now somewhat assuaged—able to see, hear, speak, and breathe freely—by the Three Rare Words of the Wood's Edge ritual, and fortified in their minds by the return of their wampum strings, the mourning Four Brothers (via their speaker) say, "Now have we completed it. The preliminary words are over. We both have rubbed down each other's bodies. Everything on our side is now ready; they shall take you by the arm and lead you to the principal bench (ganakdagweniyo"geh, the main bed), and there shall one seat you in the place where the entire business will be carried to a conclusion, as many matters as remain for us. Thus the appointed warrior chief will take you by the arm there and he will place you where benches have been prepared for you."

It was at this point that I saw Howard Skye for the Cayugas and Albert Thomas for the Oneidas, the designated Chief warriors for the Four Brothers, step across the fire and turn together to face the west entrance to the longhouse. The two warriors stood together, as custom dictated, in front of the two who led the procession on the road, the singer and the crier for the

[3] *See* the author's edition of J. N. B. HEWITT, *The Requickening Address of the Iroquois Condolence Council*, This JOURNAL **34**: 65–85. 1944.

Three Brothers. Meanwhile the host of the Four Brothers, having turned away from the fire, were making for the east door of the longhouse to find seats. Supposedly the chiefs precede the crowd into the building. Actually, many from both sides had crowded in already to preëmpt the best seats at each end.

Then the two appointed as head warriors say, "Onenh dwa'den'dya," "now let us proceed."

Again taking up the Roll Call at the place where he left off when they reached the fire, Roy Buck, who was following the path, started the procession of Three Brothers toward the west door of the lodge. Those names of founders that were not sung before on the road are sung now up to the door. It was 4 o'clock as we entered the longhouse behind them, having passed nearly an hour shivering by the fire.

At the door of the longhouse it is customary to have another man appointed to take over the Roll Call and recommence from the beginning inside the house, regardless of where the first singer leaves off. We came in and took seats on the left bank behind the chiefs, who occupied two opposite benches lengthwise of the house in the northwest corner, and a third bench placed across the west end of these facing the Four Brothers side. The latter sat on two opposing benches similarly placed in the northeast corner; I could not see a third bench from where we sat against the north wall behind the speaker's bench. Men occupied the north half of the house at both ends; women and children sat to the south. Midway of the house a wire stretched across the room, as if to demarcate the zone of the Clear-minded from the Mourners, and a blue quilt, fitted with curtain rings hung in folds against the north wall. As we seated ourselves, Onondaga Chief Peter Buck, who holds the title Gowena'seńdon', was walking slowly to and fro, cane in hand, the whole length of the house on the men's side, chanting the Eulogy of the Founders. Now it was apparent why the Hai Hai singer must rehearse. He must have the words fixed in his mind; he must remember the Roll Call, how the chiefs are related, as brothers or cousins, and how to divide the words to fit the tune. From the moment he crosses the door sill confusion greets him. The mourning side is seated, but his own crowd is coming in. Escorted to the bench prepared for them, the chiefs sit down, but the crowd scrambles for seats along the wall. The west door keeps banging (and the Lower Cayuga Longhouse door creaked badly). The air is already fouled: chiefs light up their pipes and cigars; the stoves at each end alternately radiate intense heat or smoke. Babies cry. But the measured phrases of the Roll Call go on inexorably for an hour[4]:

Hai Hai Now continue to listen
Hai Hai Our grandfathers of old
Hai Hai You did establish it
Hai Hai The Great Law (League)
(Seventeen "words" precede the first name),
Hai Hai (four times)
Hai Hai Continue to hear us
Hai Hai You who were proprietors
Hai Hai Ne Dekarihoken
Hai Hai They were related as brothers
* * * * *
Hai Hai that was the number of you
Hai Hai you did work together
Hai Hai you did found
Hai Hai The Great Law
Hai Raksot (Grandsires)

And so he goes on, mentioning all the names through the rosters of five tribes on both sides of the fire, as they are sires or offspring of each other, going through it to the very end as far as it was completed when the League was founded. Moreover, while he is walking to and fro performing the ceremony, each time he comes to that part of the chant when he says:

Hai Hai ne'to hona'deedjon''na
Hai Hai swa' deihwakhahon''gwa
("That was the number of you founders"),

then the chief so denominated cries in approbation "yoo hen^{nn}——" (in falling tone), and all the chiefs of his phratry in unison confirm (in low tone) "hii····· ye^{n}" (stressing the last).

And likewise on their side of the fire, when the tribal chiefs of the Four Brothers hear their titles announced, one after another each chief of that nation himself

[4] J. N. B. HEWITT and W. N. FENTON, *Some mnemonic pictographs relating to the Iroquois Condolence Council*, This JOURNAL 35: 301–315. 1945.

raises the shout of approval, and his own phratry of chiefs support him.

But when the enumerator reaches the vacant title for which the ceremony is going forward to install a candidate, both on the road and inside the house, according to Roy Buck, he inserts an address to the deceased chief and his ancestor:

Hai Hai Know that she (society) is grieving
Hai Hai They are mourning
Hai Hai In their minds
Hai Hai When he did pass away
Hai Hai He on whom we depended
Hai Hai He carried away with him
Hai Hai the minds of them
Hai Hai who subsist on the stump[5]
Hai Hai as the tree puts forth suckers
Hai Hai Now thou deceased one listen (hear me)
Hai Hai You were a principal one (a chief)
Hai Hai You Daga'en'yonk

There is only one principal candidate named, in this case Haga'en'yonk, first on the Cayuga list, for whom the Condolence is performed; if others are then installed they remain unnamed.

And then the enumerator continues as before until he completes the roll of the Five Nations. The Roll Call ends abruptly without flourish, leaving the singer midway of the house, from whence he returns unceremoniously to his place among the Clear-minded chiefs and sits down.

It was now 5 o'clock. It was gathering dusk outside, and the six windows, three on each side of the house, no longer admitted enough light to illumine the interior, although the logs above the wainscoting had been whitewashed. Originally built of pine logs, sometime after A. C. Parker and F. W. Waugh photographed it (ca. 1912), Lower Cayuga Longhouse evidently was rebuilt and clapboarded on the outside when, presumably, the transoms above both end doors were boarded shut. Now the two messengers for the visiting chiefs, Sam Silversmith and Bill Henry, who had guarded the singer on the road, took down the oil lamps from the chandelier at their end of the house, adjusted the wicks, lighted them, and put them up again. Simultaneously, Bob Bill and Freeman Gibson, two of the cooks who hang the kettles for the chief, fulfilling further their duties to the matrons who appointed them, came in from the cook house and lighted the lamps on the Four Brothers' side.

[5] The chief's maternal family and clansmen.

SIX SONGS

Meanwhile the two servants of the condoling chiefs drew the quilt curtain halfway between the groups of chiefs screening the mourning Four Brothers from the Clear-minded who were about to sing. Across the room the women folk could see the whole length of the house.

While this was going on, at the Three Brothers' fire before us, a cane was put across between opposing benches at the end toward the curtain and the Four Brothers' fire. Seneca chiefs sat toward the curtain end, Onondaga chiefs in the middle, Mohawks at the end toward the door, and on the flanking bench facing the far fire. Seneca Chief Adam Burning, holder of Sha'degeonyees, "Skies of Equal Length," held one end of the cane; Thadoda'ho' (Onondaga) grasped the near end; beside the latter sat the Speaker. Over this horizontal stick were draped in order all 14 (?) Requickening strings. When all was ready, Chief Logan, who at the rehearsal had been appointed to perform this role for the side of the Clear-minded, raised the first of the Six Songs. The old chief leaned forward resting elbows on knees, hands clasped; and most of his colleagues assumed the same position. Their heads were together as if deliberating some solemn question in council. Indeed, singing the Hymn of Farewell to the Dead Chief is a solemn occasion for which they had practiced. Now they excelled themselves. No other song is so sacred to the Iroquois. Nothing else quite embodies their feeling for the League. It is tragic but understandable that they will not sanction recordings. Chief Logan drew a deep breath, closed his eyes, and his clear baritone voice sang out:

Hai Hai hi hi i hi:] *repeat*
Gayanerenh De skennon—
— — — wero neh i
Hai Hai, etc.

The leader went over the song to its very ending (yenh!); then another appointed one, young Roy Buck, picked up the song

a second time from the beginning, whereupon all the chiefs of the Three Brothers' side sang in unison, continuing through the entire song until the last *hih* fell away, and in unison they echoed, "yenh!" The long sustained notes, the breathing in unison, the division of the words to fit the meter so that a verbal suffix commences a new line, and the characteristic ending strike an outsider all the more if he knows the music.

1. Hai Hai Gayanerenh deskenon—weronne' Hai Hai
   Hail Hail the League, I come to greet it.
2. Hail Hail my nephrews (offspring), I come to greet you.
3. Hail Hail The Warrior chiefs, I come to greet you.
4. Hail Hail the Matrons, I come to greet you.
5. Hail Hail Our grandsires—what they decreed.

All but the sixth song are sung in sequence. In performance, as in recordings from David Thomas, I recollect that Chief Logan sang no. 2 as his first, greeting the nephews before the League. Also, contemporary ritualists are confused about the fourth song, as to whether *wagonnigi* refers to the Matrons or to something that was established by the founding great grandfathers. Hale gives it as obsolete for "womankind." As the response to the fifth song died away, a deputy of the Clear-minded drew the curtain aside. It was then a quarter past five.

At the rehearsal, the Clear-minded chiefs had appointed Peter John to take the next part. Being a Mohawk it is easier for him to remember the words of the ritual. He arose, cane in hand, adjusted his spectacles, and glanced at the text, which he had written out in a notebook, before starting to go the length of the house between the two fires on the men's side, chanting,

GAHAWENHÄÄ''DI', "OVER THE FOREST"

1.

Hai Raksothaa'·hi'h
(The chanter prolongs the penultimate of each phrase.)
Hail, Grandfathers,
now continue to hear us.
Now do they weep mournfully,
your very grandchildren.
Now at this time
it has become ancient (people are no longer interested),
that which you all did establish,
the Great Commonwealth (the League).
Hail Grandfathers, Hail.
Only that it were true
that you might continue to hear us.

2.

Hail, Grandfathers.
This is what you said,
that society would become destitute;
and that they who are coming in later times
shall pass this way (in the ceremony).
Hail, Grandfathers.
Even now,
one is uncertain
just how to recite the ritual,
as they were wont to perform it.

3.

Hail, Grandfathers.
Now at this time,
has it grown old,
what ye did establish,
the Great League;
you have it as a pillow under your heads,
beneath the ground,
where your bodies are resting
ye who combined your affairs into
the Great Law (or the League).
Would that it were really true
that you might still hear us.

4.

Hail, Grandfathers.
Isn't this what you decreed:
In the far future this institution shall be carried on,
that the law shall be continued
by our grandchildren'?
Hail, Grandfathers!

Having intoned four verses, Peter John returned to his place among the condoling chiefs, the curtain was stretched again, and Chief Logan lifted up the final verse of the hymn, the sixth song:

6. tciyatonde·k ne'i· he
   tciyatonde·kh :]&
   Ronkesota tciyatonde·k ne'i :] D. C.
   Continue to listen, my Grandfathers.

As before, the singer went over the song completely before his assistant picked it up, when all the Lords of the League among his colleagues repeated it.

Once more the curtain was "lifted." It was now a quarter to six.

Peter John again stood up and resumed chanting, continuing from where he left off to recite the laws of the League, as he passed to and fro the length of the house. During Part 2 of "Over the Forest" he

consulted his notebook, interrupting the regular cadence of the chant, so that the words did not advance with his feet as when reciting from memory.

The founders decreed that these things would make the house firm, i.e., reinforce the League. "Having completed the structure, we made marks of identification; we crowned ourselves with symbolic horns of authority."

The founders provided for succession to office. When a chief's life sways as a giant tree between life and death, then shall his antlers of office be lifted off and set on the bed between him and the wall, for it would not do if they should be borne away into the earth by a person passing away while invested with horns. Should this happen, they said, we should all perish. The founders thought, in such an event, it would be the proper way and it would strengthen the league to replace one person with another of equal status. Should the mistake be made that anyone suffers the consequences of being murdered, then shall the corpse be placed properly next to the wall where it shall rest in the darkness.[6] (Likewise his kin are in darkness of mourning.)

[6] The late Simeon Gibson thought that this passage refers to former platform burial, either outside or within the house. At the founding of the League the proper way to care for a corpse was to dress it and put it up overhead on the ceiling (not upstairs, as there were no stairs, but on the shelf over the bed where it is dark), and abandon the house altogether. That was their "system" and they knew no better. This former practice is attested in tales of the Vampire Corpse. Young men sleep in abandoned dwellings to be awakened by gnawing; in the morning a companion is dead, mangled, and they find a corpse overhead with bloody mouth. Survivors return home and notify chiefs in council who consider and decide to change the "system": "Henceforth we shall bury a dead person underground."

The founders decided that, lest sunlight might discover the corpse to a child who habitually rummages everywhere, they would save her a possibly awful experience which would torment her mind until she learned why the corpse was lying there; they would uproot a lofty pine tree, making a great hole, and there into the pit they should cast this thing and the swift current would carry it away. Then would they reset the pine tree, and never should their grandchildren see it again.

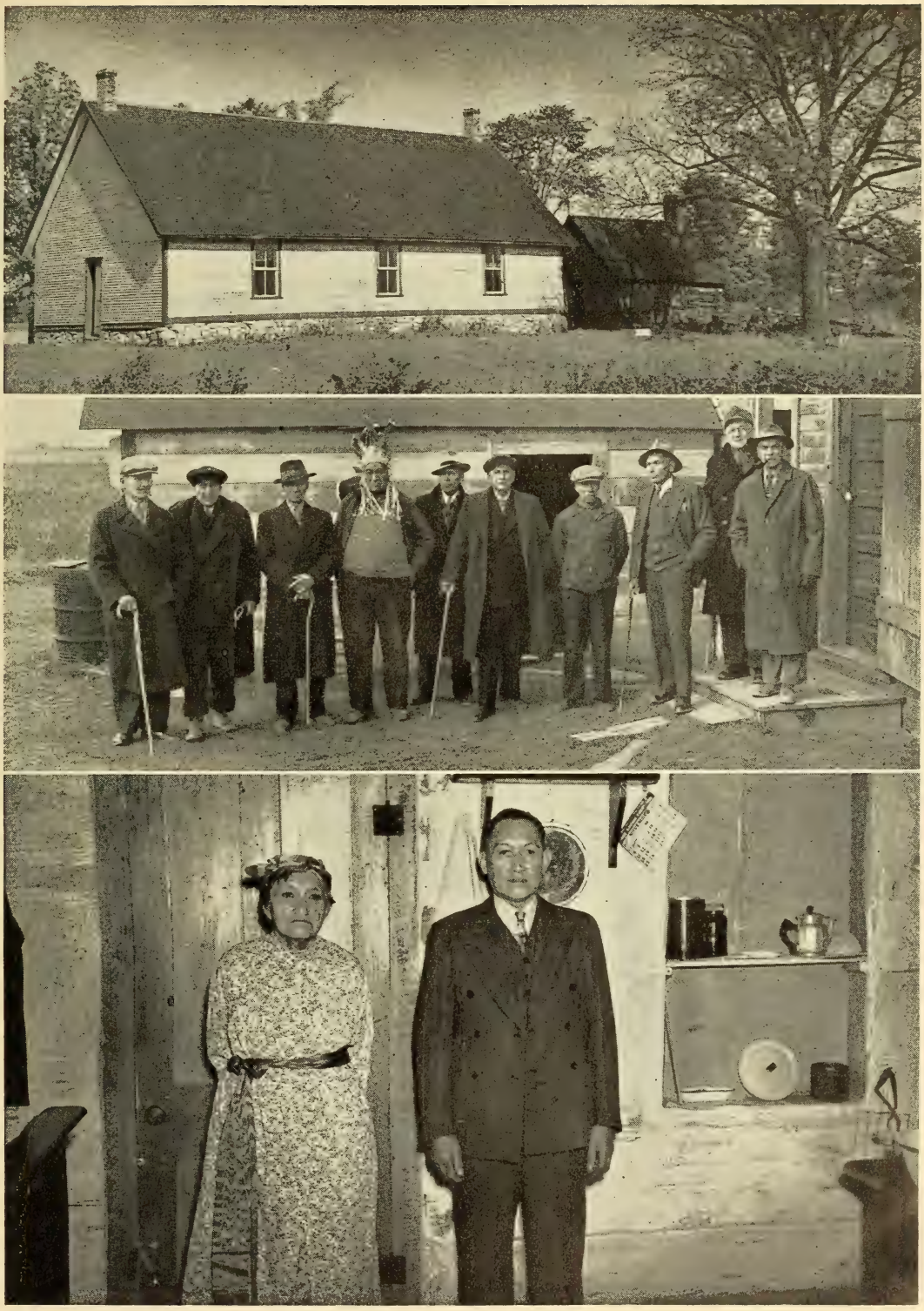
And they provided for a Condolence to strengthen the house. "Allowing that now we all wear symbols of identification, we are all invested with antlers, the pity of it being that ere we may return to our seats something may astound our momentary repose. In the event of a loss," they said, "this is what we shall do: we shall place a pole across and on it hang a pouch [of some burrowing species (?)], and in it we will drop a string, the short string of mourning, to go to either side that is mourning. Whereupon the Clear-minded shall remove it and follow the path and go to the place of mourning. There at the edge of the dust (at the bare spot around a building) one shall speak words of sympathy which at once will lift up the mind of the mourning person and comfort her. Now shall the person take up the path (resume her duties) of the Great Law (in the League).

Finally, the originator of this Confederacy
you yourself, Deganawii'dah;
and his son, Ho'datche'hde' (Oneida head chief),
ye both were joint proprietors;
and *his* father's clansman, Dehadodaa'hoh (Onondaga),
ye both were founders;
and his son, Haga'en'yonk (Cayuga),

FIG. 2 (upper).—Lower Cayuga Longhouse. From the distant road the condoling chiefs of the Three Brothers tribes entered the near (west door); the mourning Four Brothers, including the Cayuga hosts, used the far door next to the cookhouse. Photo by courtesy of Cranbrook Institute of Science.

FIG. 3 (middle).—The Clear-minded or condoling chiefs of the Three Brothers Side before taking up the path for Lower Cayuga: (left to right) James Martin, *Tekariho'kenh* (M.), Peter John, honorary Mohawk chief and chanter, Deputy chief Levi Hill, Charles Silversmith, *Hahstawen'seröntha'* (M.); Freeman Green, *Gane'säh'henh* (Oa.), Joseph Logan, *Thadodaáho'* (Oa.), William Jacob (?), *Hononwiéhdih* (Oa.), Peter Buck, *Gowenna'séndonh* (Oa.), Eulogy singer; Johnson Sandy Ganonhgei'daáwi' (S.), Doorkeeper; and William Henry (Mohawk), runner for the chiefs. Absent from the picture were David Thomas (Oa.), Speaker, and Roy Buck (Cayuga borrowed by Onondagas), singer of Eulogy on the Road.

FIG. 4 (lower).—The matron stands with the candidate for chiefship who is crowned with the symbolic antlers of office. Jemima Gibson, matron, and her brother Chief John Hardy Gibson (C.).



FIGS. 2–4.—(See opposite page for explanation).

ye both were principals;
and that one, a father's clansman,
Sgania'dai'yo (Handsome Lake) (Seneca),
you, his cousin,
a joint proprietor,
Sha'degaenhieiis (Skys of Equal Length).
(These were the founders.)
Now this is what they considered:
In later times additions would be made to the framework,
to the great sooty rafters.
Hail, Grandsires.
Now are we failing
your very grandchildren.
Hail, Grandfathers!

Ending on this note of humility, the chanter returned to the bench of the Clear-minded. It was 6 o'clock by the time Peter John had finished. When he was seated, Sai''goonah, Great Knife (David Thomas), as speaker for the Clear-minded, stood up and addressed the Four Brothers, resuming the Thirteen Matters of Requickening.

REQUICKENING (PART II)

Although not himself a chief, David Thomas has the confidence of the Onondaga council and speaks for them. From the years that they were team mates at Lacrosse, Chief Logan and David (Da'wit) Thomas have relied on each other. Now they collaborate in ritual. "Old Da'wit," as he is affectionately called, is one of the finest orators among the Six Nations. Of Christian parents, he grew up, nevertheless, among the longhouse people, marrying a daughter of Old Chief David Skye with whom he took up residence. The old chief used to rise early before daylight; Da'wit would get up and "make fire," when the old man would begin to talk about the old people, their customs, traditions, and ceremonies. Once fairly started, Chief Skye would keep on whether or not anyone was listening. But Da'wit, then a young man, would listen—chin in hands, elbows on knees, and eyes shut—concentrating on the old chief's words. Thus he heard much of the Deganawii'dah legend of the League's establishment; that is how he became versed in the lore of the longhouse, the religious festivals of thanksgiving; and by participating in the ceremonies and by dint of long practice he became a longhouse speaker. Thus Iroquois society leaves a way open for an individual to achieve what cannot be ascribed to him if his maternal family does not possess a title.

What are the qualities of a good speaker? What is it that Da'wit has that others lack? He waits for his audience before speaking. Then he commences slowly in a low, well-modulated tone of voice. He is a master of the period, allowing as much time for his words to sink in as passed in utterance, meanwhile standing with eyes nearly closed concentrating on what follows. As he warms up to his topic, the pace quickens and the words flow in swift cadence at a high tonal plane, which falls away at the end of a clause or sentence. This is the "preaching" style employed in the Requickening Address, as in other ritual speeches and prayers that are recited from memory. What impresses the white man, even after a decade of association with the Iroquois, is the utter equanimity of public speakers who carry on "in a crowd," as they say, undisturbed by crying babies, doors that bang and groan, the coming and going of children, adolescents, women, and men who get up and go out—even their colleagues, the chiefs for whom they speak. Such poise demands not only concentration but knowing the stuff of ritual thoroughly. Besides the "preaching" style, there is the oratory of the council. Argument calls up a wealth of figures of speech in which the lore of the longhouse abounds; and on such occasions Da'wit employs gestures as graphic and artful as his voice. Irony, even sarcasm, and above all a sense of humor appeal to the Iroquois as Indians.

Having cleared the "eyes," the "ears," and the "throats" of the mourning phratry of the deceased chief at the wood's edge, the speaker now proceeds to requicken the remaining organs and faculties that were impaired by the awful hand of Death. Grief, says the fourth "word," wrenches the internal organs, and the speaker rearranges them by pouring in the "water of pity."

The fifth burden wipes clean the bloody husk mat bed.

A sixth lets daylight into the deep darkness of grief. The mourning phratry regains

sight of the sky, which the Master of Life intended as a source of happiness. The eighth burden restores loss of the Sun with all that sunlight implies to a horticultural people.

The mourner's mind rolls atop the fresh grave of the dead chief, which calls for a ninth black string of wampum. Death, the Great Enigma, has scattered the bones of the Founders; the Clear-minded send over a string (of white wampum in some sets; half black and half white in others) called "Twenty Matters" with which they "do bind up the bones of the chiefs and the nation"; Twenty is the penalty for homicide. (This string goes over to the Four Brothers but does not come back until the next Condolence.)

Moreover, death has stomped in the Council Fire and kicked around the fire logs; the eleventh string restores the Council Fire (civil government) so that neighboring people may see the smoke arising and take heart.

The twelfth burden acknowledges the preeminence of Iroquois woman: birth of men, attending the hearth, preparing food, care of all that is planted; an early death leaves that much empty space in future society for the children she did not bear, and since she lacks female descendants the ashes of her maternal family become cold. The warriors are woman's assistants.

The Federal Chief follows the path of duty (XIII); his nephew (warriors) and a niece (women folk) are his immediate care; and the matron warns him when he strays from the path, but if he throws her warning over his shoulder, then the head warrior warns him of drifting from his colleagues and puts him back on the path. The nephew and niece appear a third time, and the chief warrior of the family lifts the horns of office and hands them to the owner of the title, thereby releasing the man of further duties as a civil chief.

The fourteenth burden admonishes that "anything can happen on earth," even insanity or suicide following so grievous a calamity as the death of a chief. Certain plants growing on earth are not to be fooled with; some are medicines but included in them are some poisonous plants that will kill a person should she lose her head and fool with them.[7] (A string, half black and half white.)

The last burden of Requickening speaks of the "torch of notification," by which they learned of the chief's passing, and returns to the pouch on the pole the short (purple) string which both sides own equally and use for this purpose. The string symbolizing the torch is pure white.

"These are the number of Condolence Messages."

As he spoke each of the 12 condolence messages in the longhouse, Da'wit lifted the appropriate string of wampum from the cane beside him between the benches, where the "words" were ranged in sequence, and held the string in his clasped hands until the end of the message when it says: "Now, my offspring, you Federal Chief, whom I have held to my bosom, the Word (attesting wampum string) of thy *Ado'nni* (father's clansmen) is on its way to thee." Here the deputy for the Three Brothers took the string from his extended hand and carried it over to the Four Brothers' side where it was received and hung on the cane. In all, 12 strings crossed from fire to fire during three-quarters of an hour.

But there was one other. This explains why some informants speak of Thirteen Matters inside the house, although Howard Skye said but 12 strings crossed the fire in the present ceremony. The speaker now requested the Four Brothers to pay strict attention.

Now the Three Brothers have been noticing that the mat (or bench) is empty where your colleague used to sit. The Founders of the League ordained how many trees shall stand erect on both sides of the fire and how to proceed in case a body topples on either side. In that event it shall be urgent that they shall show the candidate's face in front of the chiefs and the public, and that also they shall stand him erect and mention his name. That is why the Three Brothers came here because now the bench is empty where his bench used to be on whom the minds depended. Now that one is gone wherever it took him.

Now then, point out to us the one who is to be our colleague, so that we may think that the number of words that we have spoken here shall be fulfilled.

[7] FENTON, W. N. *Iroquois suicide*. Bur. Amer. Ethnol. Anthrop. Pap. No. 14, Bulletin 128, pp. 80–137. 1941. See also footnote 10.

Now, therefore, our means of notification (the short string of black wampum that was brought to the Three Brothers by a runner when the Cayuga chief died) now goes back to you. (Deputy carries short string across.)

Now shall you know that the Three Brothers have completed the ceremony, for this is the number of words.

Three hours had passed since the Condoling phratry had entered the longhouse; it was now nearly 7 o'clock. With the end of the address, Da'wit said, "We are now going to rise as a group and withdraw a little way as far as the edge of the brush to kneel and crouch there until further notice."[8] At once the chiefs made motions as if to leave. Some made a noise with canes; others got their hats and coats, picked up canes, and a few stood up. Across the room, Howard Skye, as messenger or chief warrior (sometimes a chief does this) for the Four Brothers, stood and briefly addressed the guests, "My uncles, we ask you kindly to remain until further notice. That is all."

Somewhat composed, the Three Brothers sat down to await a reply.

MOURNERS RETURN CONDOLENCES

It was now the obligation of the mourning Four Brothers to return the condolences of the Three Brothers. Accordingly, their deputy drew the curtain. There on a cane before the Four Brothers rested the 13 strings of wampum, which are the words of the Three Brothers. There with them also rested the Six Songs. But they too had rehearsed and they had appointed a singer and a speaker.

Only four chiefs represented the Four Brothers, of whom three are Cayuga and the other holds an Oneida title. Besides Desga'he' and Hagya'throne', there was Deyotoweh'gon, "Doubly Cold," a title which Sam Jamieson holds, and only Howanhtcade'nhon, "Covered with Mist," in the person of Levi Jacobs, sat for the Oneida Nation. S'ohee's, as deputy for Deyotowe'hgon, acted for the side; and Charley Van Every, home from Lockport, N. Y., carried the Six Songs, followed by Alex Nanticoke. This fragmentary delegation for the Younger Brother nations sat mixed without regard for rank or tribal affiliation, nor was my informant certain how they should sit.

The Four Brothers' side returned the Six Farewell Songs of the dead chief at one sitting behind the curtain, beginning at 6:50 and singing 20 minutes. They were not in so good voice as the Three Brothers. The manner of singing did not change: the first singer went through the song and the follower led off from a lower note; then all the chiefs of that side joined in. But the words differ. It is as if the past chief himself sings:

1. The Law has come to greet me.
2. My Father's kindsman comes to greet me.
3. The warrior comes to greet me.
4. The cook[9] has come to greet me.
5. Our grandfathers, what they created.
6. Continue to hear us, our Grandfathers, continue to hear us.

The last is the same as the sixth song sung by the Condolers.

The deputy for the mourners put back the curtain for the last time, and Desga'he', who made the principal addresses for that side, stood. He proceeded in great deliberation to return the burdens of Requickening. Confirming each burden, however, was briefer than condoling. Not quite a half hour sufficed. And of the 12 strings that Da'wit had sent over, only 11 were returned by the deputy, one at the end of each message. Dr. Hatt counted 10 coming back; Howard Skye said he delivered 11 to the Three Brothers' side, that the Four Brothers kept the one called Ne'Dewas'hen' niuihwa' (Oa.), "The Twenty Matters." This string is passed over by the Condoling phratry to confirm the tenth burden which says,

[8] This being the old custom to retire and await summons to hear the reply of the home council.

[9] Jemima Gibson said that each chief has a godri'hont, a female official, who is appointed in her own maternal family, at the same time that the chief is raised, for life and who is replaced at death by another, but is not the same as the goyanehgo·nah, or *Matron* who appoints her. Her duties are to cook the corn soup in making a new chief, to make corn bread (if she is smart), and to boil the meat. At a special council, if special meals are needed, the chief may call on his own cook and ask her to fulfill her duty, i.e., cook the corn soup. But we have already noted that men were cooking under the direction of women.

"Now then does one[10] gather your bones together;
With Twenty Matters do they bind up your bones."
(i.e., of the living and the dead chiefs).

This string will be returned at the next condolence held at Onondaga, when the Four Brothers will send it back; unless a second condolence falls at the same place, when the string is sent back "by a whisper" (aja'honskwa' (Ca.)). Regularly, this string keeps going back and forth whenever a condolence occurs, although, I believe, each side possesses such a string.

Except for the omission of the Tenth Matter the reply of the Four Brothers otherwise was the same as the condolence expressed by the Three Brothers.

In preparing the return of condolences, the speaker for the mourning brotherhood will say,

Now today the ruler has made just as he prepared the daylight and even the earth, and he created us people, and, therefore the number of us present. Now we are two groups met together, my uncles. And, moreover, already did you make an address, and so it is the turn of the Four Brothers to reply. Therefore you shall all think that we have accepted it too, just as you delivered it. Now you did finish speaking. Furthermore, this is how our grandsires have ordained; they composed words for carrying on on whichever side of the fire the chief may have died. And then the clearminded shall come in at the door (of the mourner). Accordingly you are following this path, my uncles. And what is more it isn't just on one side (death may befall either side): it is happening to both of us alike. Thus from day to day they are toppling over close to thy person, they are dying continually, thy very newphews and even thy grandchildren. Consequently right now it is twisting within your mind. Therefore, now they have poured in the decoction of sweet flag (water of pity), and when it has settled down it will permeate throughout your body. Then shall you feel well disposed in the future, and you shall continue to enjoy health for a day at least.

* * * * *

This is the way the Four Brothers may do, repeating then the 13 (?) strings exactly as given by the Three Brothers.

SHOWING THE NEW CHIEF'S FACE

It was 8 o'clock by the time the Four Brothers had sent the last of the Requickening strings back by their deputy. Now Desga'he', their speaker, took the center of the floor beside their fire, and, leaning on his cane, addressed the Three Brothers:

You now have the completed words of both of us, the number of my father's kinsman. And now it will be possible to show his face right here before the crowd. Now one will raise him to a standing position in front of the chiefs and also one shall call his name, which is that of the dead chief. Now another thing, one will place him in the vacancy. Now, moreover, my father's kinsmen, you shall think that events have transpired here just as you specified when you did say, "Now show us the new man who will be our coworker from now on." Therefore, be alert for this is the real thing! Now you shall take a good look at him. For we are now going to show you your future colleague!

Although others besides myself including some of the Chiefs on the Three Brothers side knew who was going to be the chief, no one let on, and the tension built in five hours of ceremonial reached a climax. The building overflowed with anxious humanity; just before this Dr. Hatt had counted over 80 persons over on the women's side, but now others crowded in at both doors, standing up to the stoves, to see the new chief. Probably the crowd touched 250 at its peak. Jemima Gibson, matron of the family holding the title Haga'enyonk, arose as Desga'he' was speaking and crossed calmly from her place among the Cayuga matrons in the southeast corner to where her brother was sitting in a complimentary place among the Cayuga men in the northeast corner. Taking her brother Hardy by the arm, she raised him to his feet and escorted him to a position just flanking the fire on the speaker's right (Fig. 4). As this action occurred, the Chiefs of the Three Brothers' side and the multitude craned their necks to see the new chief. There they stood, the speaker in the middle of the house, the matron on his right, and the candidate on her right, facing the Three Brothers' side.

Now the speaker for the Four Brothers side went on, "Now all of you look here, for he is standing here before you, the one who was appointed by the owner of the title which reposes in that continuing lineage, the Bear Clan, whose bench was made empty where their late great one used to

[10] Throughout the ceremony, as in Iroquois generally, the third person singular feminine, "she," stands for society; "it is as if a woman is doing it."

sit." (Here the speaker mentioned that the deceased Haga'enyonk, the late Abram Charles, was a member of that clan, and that he had been qualified as a chief when yet a boy, but he did not state the details of his elevation.) "And further, this one (the candidate) who came and stood there in front of you is the one whom they are crowning with antlers (of office) and henceforth you all shall denominate him Haga'-en'yonk." (This name he repeated for emphasis.)

Actually, the candidate was crowned the moment the matron stood him up.

"Now, therefore, here is the means by which you may hear the title, Haga'en'-yonk." (He held in his hand a string of white wampum which, when he had finished speaking he passed to his deputy who carried it across the fire.) "It shall now go across the fire; it is the word of all who have combined their voices with the proprietress of the chief's name, comprising both the siblings and the cousins who sanctioned it; and also the entire group of relatives have approved it; even the tribes known as the Four Brothers are of one voice. Now, therefore, it shall cross the fire, now their word by means of which you shall be notified, is on its way over my Father's Kinsmen, the Three Brothers" (string).

Ordinarily the matron of the nominating maternal family chooses a lady to stand with the new chief, to serve as his guardian, and also to cook for his feast, according to Simeon Gibson. But Jemima, the matron herself, stood alone with her brother, and no man was installed as deputy to run his errands. Younger members of the family had refused to accept responsibility. Accordingly, the orator referred only to the matron, if he said, "Furthermore, this person will be his guardian to stand at his back as the women owners of the chief's title have severally agreed, and they have attached her to his body and stood her to the forefront at the head of the women of the maternal family of that clan when they stood him in the chiefship. She shall be called (name of head female of chiefly family), for which this string of wampum will cross the fire."

The deputy of the Four Brothers carried the string of notification across to the Three Brothers' side. The first chief took it, handled it, and passed it on to his colleague; and so the string went around the fire in a counterclockwise direction. Each chief touched the string as it passed among them; taking hold of the wampum is tantamount to consent. Each chief has his own string, called "his guardian." This goes over the fire, and every chief handles it as it circulates in the council confirming the appointment. Earlier informants said that this string is returned with a speech, but Howard Skye asserted that this string is gone so far as the matron is concerned. One such string, anyway, is kept by the matron who watches the chief. Jemima, the matron, returned to her place among the women, leaving her newly crowned candidate to the scrutiny of the Three Brothers.

But the Three Brothers did not reply as yet, because the Four Brothers had yet another candidate. The installing speaker continued; yet another title was vacant in the Cayuga roster. Mrs. Charles Bomberry of the Ball Clan arose and led forth Bill Johnson, a Cayuga Warrior in his forties. She stood on the speaker's left, her candidate at her left; a man who was to be his deputy, and a third youth, who was being installed as a longhouse official, manifested subordinate rank to the first by standing in echelon formation to the rear at his right. To these Desga'he' pointed with his cane and announced that the first was being installed as Gadji'nonda'wehe', in the Ball Clan, and that as such the latter and the previous candidate, Haga'en'yonk, were as "sons to each other," a relationship that is difficult to explain but that the Iroquois accept with equanimity. Each Cayuga chief has one matron and two assistants: a guardian or deputy who is the chief warrior and an official for ceremonial occasions. These things having been explained, and the status of the others in relationship to the federal chief having been defined, the matron and the third male candidate for longhouse office retired, leaving the two leading Cayuga chiefs, Gibson and Johnson, and a lone deputy, facing the Three Brothers' side.

With respect to the first office to which

Hardy Gibson had been raised, the Onondagas, to wit, Joseph Logan and Peter Buck, asked for the details attending elevation of his predecessor, the late Chief Abram Charles. The Onondagas wanted to know how the previous candidate was qualified. Their speaker mentioned that this office had originally belonged to the Deer Clan. How was it that the Bear Clan now had it? The Four Brothers acknowledged this as a fact but stated that the present candidate was being installed on the same basis as his predecessor. The Deer Clan then had no suitable candidate, the title had virtually been transferred to the Bear Clan, and meanwhile the ashes of the Deer Clan had become cold. This would mean that the family line had died out.

The Onondagas next asked the candidate whether he had ever voted in an election for the elective council, which superseded the confederate council of life chiefs when the Indian Act went into effect about 1928. To this question Hardy Gibson replied that he was always a follower of the old system of chiefs, that they might recall that he had served as a deputy to his late uncle in the old council, and that he intended to keep up the old system for the benefit of generations to come. He was finally asked to speak. He acquitted himself well, amazing many that he commanded so well the ancient forms relating to the League.

In the examination of the second candidate it came out that this title also had belonged to the Deer Clan. But Mrs. Charles Bomberry is Dowen'he'gaa' (Ball Clan) and, having no eligible candidate in her family line, she was conferring the honor on Bill Johnson, a member of the same clan, according to my notes, but it was my impression at the ceremony that he had been selected from another line. If, however, both leading Cayuga chiefships were originally in the Deer Clan, or even in the same clan, we may have a clew to why they are called "the two sons" and why each calls the other "son."

Again the candidate was questioned as to whether he had ever voted for the elective chiefs. Some persons in the crowd thought this unnecessary because the candidate had always been identified with the Onondaga Longhouse, where he is known as a great worker, but others around me, members of the Mohawk Workers Party, considered the answer quite important. But the candidate demonstrated that he will probably make a good chief; he sidestepped the issue by saying that the only way is the old way. The Onondagas were satisfied. The Mohawk workers were not, but since they were not chiefs it did not matter. The Three Brothers were satisfied.

CHARGE TO THE NEW CHIEFS

It was now 8:40. Having seen the string, and all taken hold of it, the speaker for the Three Brothers then stood to say: "Now it is indeed fulfilled: we have looked over the new one on whom you have placed the antlers of office and also his guardian the lady who owns the title; we accept both of them as we are notified by your word. Therefore the Three Brothers have now sanctioned (accepted) the two new candidates whom you have elevated. Now then get ready to hear something, you two candidates on whom they have just placed the antlers of chiefship." Whereupon the speaker sat down.

It was Chief Logan, Tadoda'ho himself, the leading chief of the confederacy who arose to make the charge. This was a great moment because Chief Logan not only holds an important office but he is a forthright person of great integrity. The public knew that the chiefs had entrusted this responsibility to him knowing he would fulfill it as the occasion demanded. Carrying a heavy bent wood cane of a type stock men employ in grading animals, Chief Logan crossed to the Four Brothers' side and confronted the two newly installed chiefs (Fig. 1). Speakers vary in how they discharge this role. According to my informants Chief Logan said:

> It is an amazing thing that what the Founders of the League established many years ago is still going on at the present time. The Founders of the League believed that a child was born of virgin birth and so he remained to do away with the blood-feud and other causes of unhappiness among the people in the early days. And that system has worked right up to the present day. Now you two are the leading Cayuga chiefs; Daga'enyonk and Gadji'nonda'weheh. As such you are

as sons to each other. Each shall call the other "my son." You two are the firekeepers of the Cayuga Nation. It is your duty to preside together at the councils of your tribe. But although you two are the leading Cayuga chiefs, you are no higher than the rest. All chiefs are of the same height.

Having addressed these and other remarks to the chiefs and the public, Logan emphasized the following virtues of chiefship menacing each of the new chiefs with his cane, as if everything depended on them:

You should do all in your power to protect and benefit the people and their children as well as the generations to come. Everything depends on you. The welfare of the people depends on how you deport yourselves. Remember always that the chief's skin is of seven spans in thickness (wa'sagondaden'sta' djowenhgaa'da') (the span of the thumb to middle finger, measured as an inch worm jumps). You will hear a lot of people talking, criticizing. Seven spans of skin will protect you. You will live clean lives so that the people will have great respect for you. You both know the evil spirit and the good spirit.

I am in a hurry now (turning away). There are many more things that I should say, but I am now at the point where I need food. (The speaker always makes a joke of this sort to prompt the cooks; sometimes he says the young girls want to dance.) But I trust that you will do the right thing.

Chief Logan had already returned to his place when he remembered an addendum. "I almost forgot," he said, "that you should know when the chiefs hold their councils. They meet on the first Tuesday of the month at the Onondaga Longhouse. It is your duty to attend."

At the end, after the Three Brothers had accepted them and charged them with their responsibilities, Hagya'trone' and Desga'he' solemnly took the two new chiefs by the arm and seated them among their colleagues.

The above account, observation coupled to remarks of informants, compares unfavorably with a typical text for the same (John A. Gibson to A. A. Goldenweiser, 1912):

CHARGE TO THE NEWLY INSTALLED CHIEF AND HIS GUARDIAN

They have thickened your skin so that it is now seven spans of the measuring bug, which henceforth shall be the thickness of your skin. And this means too that your mind shall be firm, not letting anything penetrate it (gossip especially), for possibly something pointed might stick into your skin when you come to take up your work for the cause of Righteousness, Peace, Justice, Law, and the League. For, indeed, you have now become the protector of the families of your nation.

And this is what he will say, "You shall be good natured, and what is more you shall love the people. And don't distinguish between any man, whether he be wealthy or poor, good natured or evil natured, or even very wicked; all of them you shall love equally not excepting anyone. And furthermore, in your consideration don't ever permit yourself to be selfish, thinking only of your self, but always remember the elderly people, the children too, and even those who are yet unborn under the ground have their faces coming this way. Always think of them in your deliberations so that everyone shall continue to be well disposed toward the successive generations of families. And then shall your grandchildren continue to prosper."

These are all of the words.

[And now turning to the matron and the deputy chief, whose responsibility it is to guard the chief.] Now, moreover, you shall obey that woman who is guarding your body as chief; and as for you yourself (addressing the matron) never let it happen that you spoil the word of your great one who is representing your maternal family.

Now, therefore, all of you chiefs shall be of one mind toward the newly installed one who will be your co-worker. You may now resume your combined duties toward the Great Law (League).

So these are the number of words. Now this ends the message of the Three Brothers.

With the seating of the new chiefs, we made a break for the door along with others who had sat through five hours of continuous ceremonial. Outside the moon had come up and it was crystal cold. Men returning from the brush were gathered in little knots to talk, others walked the circuit around the building that had been worn bare by generations of dancers cooling off. We paused to chat a moment with Tom Longboat, one-time Olympic marathoner, who had retired from Toronto to live in leisure among his Onondaga tribesmen. Tastefully attired in a dark overcoat of good make, a silk muffler in Paisley design, and a gray felt hat, Tom removed the pipe from his mouth, smiled, and remarked that he had enjoyed the ceremony, which he too was seeing for the first time. We went back inside to recover our seats. But that was a vain hope because others had taken them.

FEAST

We stood in the crowd by the west stove as pairs of cooks carried in steaming kettles slung on poles over their shoulders. Coming in at the far end of the building, they set a kettle down between the benches occupied by the Three Brothers' chiefs, and another for the Four Brothers. Others bore in trenchers and basket trays of chunk beef, which was distributed to the chiefs who eat first before the public. Deputies of the chiefs shared in this work, carrying the great baskets of sliced white bread from Jones's bakery in Caledonia, which they distributed among the crowd in a counter-clockwise direction. Nearly 150 pounds of beef, a hundred-odd loaves of bread, a sack of flour, 12 quarts of Indian white corn, and assorted groceries had gone into the cooking. The whole expense devolved on the family of the new chief and his kindred. (Actually the Viking Fund through the Smithsonian Institution and the Cranbrook Institute of Science had subsidized the feast.) But even so it was a small feast per person; Hardy Gibson told me that it used to be even more expensive to install a chief a generation ago. Then when less cash flowed into the Reserve, it nevertheless cost several hundred dollars. One had to buy a steer or two and the matron enlisted a number of women to make the corn bread. More labor went into the preparation and a larger crowd attended.

While the cooks were bringing in the kettles and during the hour from nine until ten that passed in feasting, several of the Three Brothers' chiefs were moved to speak. It is customary at this time for the hosts to inquire whether any of the chiefs have dreamed something, i.e., had an inspiration.

Meanwhile when outside we had missed the final address of the Four Brothers releasing the condoling chiefs at the end of the Charge to the new chiefs; the speaker for the Clear-minded Three Brothers had said, "Now that together we have finished the work and all is clear between us, you and I are free." And the Four Brothers replied:

Now then, my father's kinsmen, together you and I have finished everything. Therefore you shall be informed that the Four Brothers have prepared a feast. Accordingly the time being shall be devoted to this. And so let us eat together for a while. As soon as our meal is finished then the time shall be devoted to rejoicing together because the new one has been elevated that he may strive for the welfare of ongoing generations of our families. Now then we all shall rub antlers (name of the social dance of chiefs), you chiefs. Now, moreover, it is up to the crowd to have a good time.

So now, my father's clansmen, I now let escape from my hands our womenfolk. Accordingly you shall use them properly. Don't anyone treat them too roughly! (This remark always elicits much laughter.)

So now another thing. Time may also be devoted to something else. Perhaps one of you may have had a dream (some news to relate). Then in that event let us amuse our minds with dreams.

Meanwhile they eat the feast. Usually before anyone has an inspiration among the Three Brothers, one of them will reply, "No, we have no dreams to relate. We are young people yet and do not sleep much." (The implication is that they are out all night and have no time to dream.) But sometimes one may reply, "We have only one man here who sleeps much, and he has an inspiration." Then the speaker tells what he has dreamt, which is sometimes a pretense.

On the present occasion, Jim Martin (Tekariho'kenh), the leading Mohawk Chief, was speaking when we returned to the longhouse. Not being at home in Mohawk and rather weary of Iroquois anyway, I was not listening, except in a general way, to what seemed to be a tirade directed at the Indian Act and the Indian Department in Ottawa. Chief Martin interspersed his Mohawk with enough English to let me think that I need not pay attention, when I was brought up short with, "Ne' Washington, Ne' London, Ne' Moscow——Ne' Atomic Bomb!" The Condolence Council of the Iroquois in the Atomic Age!

One other speaker addressed his remarks to a felt need for returning to the ways of the ancestors. He hoped that in the contemplated revision of the Indian Act that a way would be open for a return to government by life chiefs.

RUBBING ANTLERS

Chief of the Three Brothers' side conducted the social dance that followed the

feast. Roy Buck and another acted as floor managers, picking out the singers and dance leaders.

Leading off with the Trotting or Standing Quiver Dance, Onondaga Chiefs Peter Buck and Joe Logan turned out all the chiefs from both sides. They chugged around in fine humor, Pete Buck leading and Joe Logan supporting him, and the column of chiefs rubbing antlers was soon lengthened by a throng of dancers until the circle lapped itself three times. One wondered that these old men could keep up the pace.

Tcin'ha', or Garter Dance, came next. Roy Buck and Billy Buck, a famous singer, were the leaders. They soon had a throng following them. By this time the house was filled with dust and smoke and the heat of dancing. Outside couples were walking around the building cooling off. John Buck III, who lays cable for the telephone company in Hamilton, approached me because he understood that I had succeeded John Hewitt who had employed his father as informant. While we were talking, Jake Styres joined us, also the son of a chief who had served Hewitt. Jake might have been Deputy Chief to the newly installed Haga'-en'yonk, but he had demurred when the matron approached him. Employed for years as a miller in Caledonia, he has been too long among the white people, and matters relating to chiefship, he said, were too deep for him. Successful though they may be, the younger Iroquois decline to accept such responsibility lightly. He, too, was seeing his first Condolence.

We returned inside for the Fish Dance. It was now after 11 o'clock. The crowd danced until after 12, we were told, but we went out to our cars that were now covered with frost and drove home to Ohsweken to put down our heads for the night.

ZOOLOGY.—*Rhizocephala from New England and the Grand Banks.*[1] Edward G. Reinhard, Catholic University of America.

This paper, although dealing with only three species, includes all but one of the Rhizocephala at present known from the North American coast between Cape Cod on the south and Newfoundland on the north. The three discussed here are parasites of hermit crabs. The other species known to occur within this region is *Sylon hippolytes* M. Sars, which Hoek (1888) reported under the name *S. challengeri* as a parasite of the shrimp *Spirontocaris spinus* collected by the *Challenger* Expedition off Halifax, Nova Scotia.

The Rhizocephala from Greenland and Canadian waters, together with others from the eastern North Atlantic, have been treated in an extensive paper by Boschma (1928). Two of the species we include here were covered by Boschma from the standpoint of anatomy, taxonomy, and distribution, viz. *Peltogaster paguri* Rathke and *Clistosaccus paguri* Lilljeborg. Discussion of these will therefore be limited to new information on geographical distribution and notes on the larval stages of the first mentioned. The remaining species is new and its description is published herewith.

The collections of the United States National Museum, through the kindness of Dr. Waldo L. Schmitt, have been used in the preparation of this article. It also contains hitherto unpublished results of field work done by the author at Woods Hole, Mass., and Lamoine, Maine.

Family Peltogasteridae Lilljeborg
Genus **Peltogaster** Rathke
Peltogaster paguri Rathke

Fig. 1

Material examined.—All the specimens enumerated in the following list were found on *Pagurus pubescens* Kröyer:

Off Newfoundland, 45° 44′ 00″ N., 49° 45′ 00″ W., 35 fathoms, June 25, 1885; three specimens on three hosts, *Albatross* coll. U.S.N.M. no. 80456. (Sectioned one.)

Off Nova Scotia, 44° 28′ 00″ N., 60° 15′ 15″ W., 36 fathoms, July 7, 1885, eight specimens

[1] Received December 18, 1945.

on eight hosts, *Albatross* coll. U.S.N.M. no. 80453. (Sectioned one.)

Off Nova Scotia, 43° 37′ 00″ N., 49° 56′ 30″ W., 36 fathoms, June 24, 1885, two specimens on two hosts, *Albatross* coll. U.S.N.M. 80455.

Frenchmans Bay, Maine, littoral zone, July and August, 1938–1941, 455 specimens on 424 hosts, E. G. Reinhard coll. (Sectioned many.)

Casco Bay, Maine, 1873, one specimen on one host, U. S. Fish Comm. coll. U.S.N.M. 80458. (Examined by clearing.)

Off Cape Cod, Mass., 42° 01′ 00″ N., 68° 00′ 30″ W., 86 fathoms, August 30, 1883, one specimen on one host, *Albatross* coll. U.S.N.M. no. 80457. (Examined by clearing.)

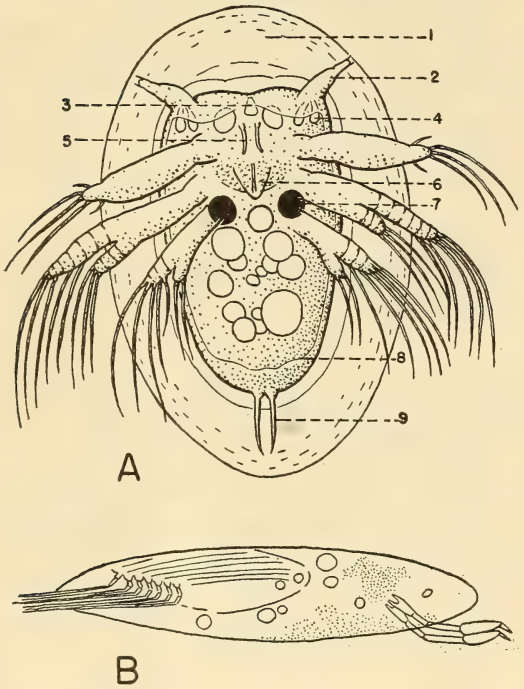


FIG. 1.—Larval stages of *Peltogaster paguri* Rathke: *A*, Early nauplius, about 24 hours after hatching, ×150; *B*, cypris larva as it appears when serving as a complemental male, ×150. (1, dorsal shield; 2, frontal horns; 3, unpigmented eye; 4, frontal glands; 5, frontal filaments; 6, labrum; 7, pigmented vesicle; 8, inner margin of dorsal shield; 9, caudal spines.)

Peltogaster paguri was first recorded for North America by A. S. Packard, Jr. (1866), who found a single specimen at Eastport, Maine. Boschma (1928) questioned the validity of this record and more so that of S. I. Smith (1884) who mentions this rhizocephalid on *Pagurus pubescens* off Laborador. His contention was that these two localities lie too far north for this species and that in all probability the parasite in question was *Clistosaccus paguri*.

It is now possible to state on the basis of the distribution records given in the present paper that Packard's identification was doubtless correct. The occurrence of *Peltogaster paguri* on the coast of Labrador, however, must still be held suspect.

Larval stages.—Nilsson-Cantell (1921) described and figured the first stage nauplius larva of *Peltogaster paguri*. In essential details his figure is a good representation of the nauplius before it is quite ready for expulsion from the mantle cavity. The shape then is somewhat triangular, and the frontal horns are directed outward and slightly backward. The size at this time is about 0.21 mm.

The nauplius described here (Fig. 1, A) is the free-swimming larva some 24 hours after it has been normally expelled from the mantle cavity. In this stage it is longer, about 0.28 mm excluding the shield, and somewhat egg-shaped in dorsal view. The frontal horns are now tilted forward and the anterior margin of the animal, while still convex, is slightly incised in front of the eye.

A prominent dorsal shield, extending beyond the tips of the frontal horns and the caudal spines, encloses the frontal, lateral, and caudal margins of the animal. It is a transparent, girdle-like covering, marked with ribs that form small diamond-shaped patterns.

The larva itself is colorless, as are the numerous fat droplets that it contains, but it possesses two pigmented vesicles, golden-orange in color, located at the level of the third pair of appendages, which are very distinctive in the living animal. The eye is unpigmented.

In side view the dorsal surface of the nauplius is convex, the ventral surface somewhat flattened except for an indentation at the anterior margin of the abdomen. The first and third pairs of appendages are about equal in length, while the second pair is slightly longer. All bear long hairs at the distal extremities. The number and position of these hairs are shown in the drawing. The spines at the tip of the abdomen are fairly long and slender. Mouth, alimentary tract, and anus are absent. Labrum and frontal filaments are present as in other rhizocephalan nauplii.

It is difficult to understand why Nilsson-Cantell remarks that in the larva of *Pelto-*

gaster paguri "ein deutlich abgesetztes Rückenschild fehlt." The dorsal shield is present in the majority of nauplii that are normally released from the egg membranes, but since it is not very securely fastened to the animal it may often be lost. It is possible, however, that the nauplii that Nilsson-Cantell studied were too immature to possess a distinct dorsal shield.

The cypris male (Fig. 1, B) is a slender larva entirely enclosed in a bivalve shell except for the antennae which project considerably beyond its anterior edge. The dimensions of the shell average 0.37 mm in length, 0.08 mm in height, and 0.03 mm in thickness. Its surface is smooth and colorless. The living animal within the shell shows spheres of orange color, which are scattered fat globules of various sizes.

The prominent antennae resemble a pair of grasping legs. Each is composed of four segments attached to a forklike tendon at the base. The first two segments are cylindrical, the third is broadened somewhat, and the fourth forms a sharp spine for piercing. These organs are inserted at a distance of about half their length from the extreme forward tip of the shell and emerge through the ventral gap between the valves. A small eye spot is located in front of the antennal tendons. The only other visible appendages are the short swimming legs. These consist of a basal segment and two small rami, each ramus being 2-segmented and terminating in several long stiff hairs that project through the posterior gap of the shell to form a conspicuous caudal tuft.

Clusters of these cypris larvae have been found on a number of occasions within the incipient mantle openings of the very young external sacs of *Peltogaster*, and a previous paper has dealt with their function in the reproductive cycle of this species (Reinhard, 1942a).

Peltogaster naushonensis, n. sp.

Fig. 2

The host of this rhizocephalid is a small hermit crab *Pagurus annulipes* (Stimpson), which is abundant and of general distribution throughout Vineyard Sound and Buzzards Bay on every sort of bottom from 2 to 17 fathoms (Sumner, Osburn, and Cole, 1913). It is rather surprising that this parasite has escaped observation until now, and credit is due Martin D. Burkenroad for calling the author's attention to it. Mr. Burkenroad brought in a live specimen at Woods Hole, Mass., on August 25, 1943. A few days later the author examined 35 hosts from the same locality and obtained one additional specimen. During the following summer Dr. John A. O'Brien, Jr., secured two more examples of this parasite through examination of 36 *P. annulipes,* also at Woods Hole. The infestation rate therefore appears to be about 4 to 5 percent.

Sections were made of the first two specimens obtained. One set of sections, designated as the type, has been deposited in the collections of the U. S. National Museum.

Types.—Holotype, U.S.N.M. no. 80916 (five slides), Tarpaulin Cove, Naushon Island, Vineyard Sound, Mass., 8 fathoms, on *Pagurus annulipes* (Stimpson), collected August 25, 1943, by M. D. Burkenroad; paratype, U.S.N.M. no. 80917 (whole specimen), Woods Hole, Mass., collected August 1944 by J. A. O'Brien, Jr.

Diagnosis.—Sacs solitary, length about two and one-half times breadth; stalk at center af dorsal surface with small shield; mantle opening at anterior end. Colleteric glands simple, accompanied by ganglion near their midregion. Testes short and saccular, at region of stalk, with long straight vasa deferentia. Retinacula absent.

Description.—The living animal is pale pink in color and its roots light green. The external sac is small, in conformity with the size of the host, and measures in the type specimen 4 mm in length and about 1.5 mm in width and thickness. The other specimens were of the following dimensions: 3.2 mm by 1.2 mm; 3.0 mm by 1.2 mm; 2.8 mm by 1.1 mm.

The mantle opening has the form of an elliptical slit guarded by an elevated sphincter. The stalk is located at the center of the dorsal surface and arises from a thin slipper-shaped chitinous shield. In its general external features the animal resembles a small *Peltogaster paguri* except that it is already mature at a size when the latter species would be less than half-grown. All four specimens had the mantle cavity filled with eggs.

The mantle is rather thin and measures 13μ to 18μ in thickness over much of its extent, although occasional areas may measure as much as 45μ. In the type specimen the visceral mass is distended with strings of eggs and has an obovate form in cross section. In the other

specimen sectioned the form of the visceral mass is much narrower since ovarian eggs are relatively few.

In studying the serial sections in order, the colleteric glands appear first. These begin immediately in front of the shield and continue to the level of the middle of the stalk. They are dorsolateral in position and have a simple or forked lumen. Just before reaching the stalk the sections begin to show the ganglion, whose main mass coincides with the anterior edge of the stalk. The ganglion has the appearance of a squat triangle, its apex extending ventrally between the colleteric glands and its base directed toward the shield.

The left testis begins immediately behind the ganglion and appears in the same sections which contain the posterior portions of the colleteric glands. The right testis begins somewhat farther back, posterior to the colleteric glands. Both are short bag-shaped organs whose entire extent is confined to the limits of the stalk. Each measures about 130μ in length. The testes are enveloped by a heavy connective tissue theca of wavy fibers but do not possess a basement membrane.

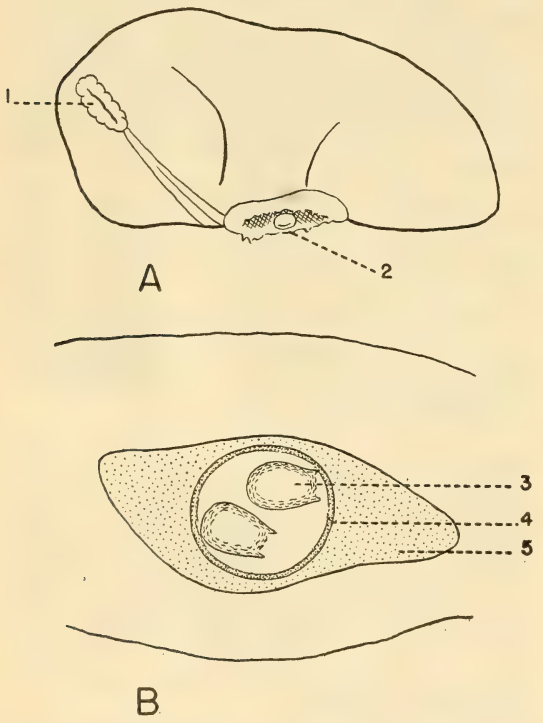


FIG. 2.—*Peltogaster naushonensis*, n. sp.: *A*, Ventrolateral view of type specimen from *Pagurus annulipes* (Stimpson), Woods Hole, Mass., ×15; *B*, portion of cleared specimen, region of stalk, showing position and shape of testes, ×70. (1, mantle opening; 2, attachment to host; 3, right testis; 4, stalk; 5, chitinous shield.)

The vasa deferentia are about twice as long as the testes. They emerge abruptly and extend as straight tubes a distance of about 264μ to emerge on the lateral surface of the visceral mass near the posterior limit of dorsal shield.

In the shape of the testes, the position of the ganglion, the uncoiled vasa deferentia, and the absence of retinacula this species is sharply distinguished from *Peltogaster paguri* Rathke.

Family CLISTOSACCIDAE Boschma
Genus **Clistosaccus** Lilljeborg
Clistosaccus paguri Lilljeborg

Material examined.—Off Newfoundland, 45° 44′ 00″ N., 49° 45′ 00″ W., 35 fathoms, June 25, 1885; one specimen on *Pagurus pubescens* Kröyer, *Albatross* coll. (Sectioned.)

Off Nova Scotia, 44° 28′ 00″ N., 60° 15′ 15″ W., 36 fathoms, July 7, 1885; four specimens on one *Pagurus pubescens* Kröyer, *Albatross* coll. U.S.N.M. no. 80454. (Sectioned one.)

Clistosaccus paguri has previously been collected in the Atlantic waters of the Western Hemisphere only from the west coast of Greenland (Boschma, 1928). These records extend the known range of this species south to the Grand Banks, where it overlaps the northern limit of *Peltogaster paguri* Rathke. At both stations *Clistosaccus paguri* and *Peltogaster paguri* were present on the same species of host crab.

The specimen collected off Newfoundland measured 20 mm in length. It was sectioned and gave evidence of being a senescent individual with degenerating visceral mass and greatly atrophied testis and colleteric glands. The four parasites on the other crab varied from 11 to 13 mm in length. This host, a female of 20 mm carapace length, also bore two scars where former parasites had been attached. One of the larger clistosaccids was sectioned and the internal anatomy was found to be characteristic of this species.

The first-mentioned specimen and three of the four others were unusual in having the mantle opening directed backward. Such a reversed orientation often occurs in cases of multiple parasitism (Reinhard, 1942b). The C-shaped mantle opening and broad stalk of attachment, important external diagnostic

features pointed out in the case of specimens from the Northwest Pacific (Reinhard, 1944), were likewise present in these specimens from the North Atlantic.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

GEOLOGICAL SOCIETY

625TH MEETING

The 625th meeting of the Society was held at the Cosmos Club, January 10, 1945, President L. W. CURRIER presiding.

Informal communication.—C. MILTON discussed caliche-top-coated cobbles from a glacial moraine in northwestern New Jersey.

Program.—C. L. GORDON: *Attack of minerals by acids at elevated temperatures.* Refractory metals and alloys of the platinum group, such as the native grain platinum minerals, can be easily prepared for analysis by solution with hydrochloric acid and suitable oxidants in sealed tubes at temperatures up to 300° C. The method is less laborious than preparing solutions by fusion methods and has another advantage in that the solution obtained does not contain undesirable amounts of alkali salts. The solution of many refractory oxides and silicate minerals is successfully attained by the simple method of sealing the mineral with hydrochloric acid in a Pyrex glass tube and heating. On the microscale this method requires no other precaution than that the heating be conducted in a uniform manner.

Details of the sealed tube technics are published as Research Papers 1614, 1621 and 1622 in the Journal of Research of the National Bureau of Standards.

As a result of trials of the method of silicate minerals it was found that decomposition of the albite-anorthite series of plagioclase feldspars was not uniformly graded from complete for anorthite to none for albite. There is an abrupt change at $Ab_{40}An_{60}$ corresponding to about 58 percent silica, above which solution was not appreciable and below which solution was complete. This is thought to be the first clearly defined evidence for "resistance limits" (as shown by Tammann for several series of alloys and for a series of synthetic mixed crystals) in an isomorphous natural mineral replacement series.

K. J. MURATA and W. G. SCHLECHT: *Chemical behavior and crystal structure of silicate minerals.* The two kinds of behavior, gelatinization and separation of insoluble silica, shown by silicate minerals when decomposed by acids, have been correlated with the internal structure and composition of the minerals (Amer. Min. **28**: 545–562. 1943). A further study of 44 minerals with continuous, 3-dimensional silicon-oxygen and aluminum-oxygen structures, such as feldspars and zeolites, has been made, and the way in which the aluminum-silicon ratio determines their behavior is emphasized. Such minerals with an aluminum to silicon ratio smaller than 1:2 will separate insoluble silica, while those richer in aluminum will gelatinize.

On the assumption that the acid treatment dissolves away aluminum from the aluminosilicate structures and leaves behind silicon-oxygen clusters, the gelatinization behavior is thought to depend on the sizes of these clus-

ters. If they are small enough to dissolve in the acid, they will form a gel; otherwise they will separate as insoluble residual silica. X-rays do not show the arrangement of the silicon and aluminum atoms with respect to each other in the crystal structure; but the behavior of the minerals toward acids shows that in the gelatinizing minerals the arrangement must be such that small clusters of silica are released when the aluminum is dissolved away. A theoretical study shows that such a arrangement cannot be random, but must have as regular a pattern as possible, in the ranges of composition that occur. Calculation of the distribution of cluster-sizes shows that in a random arrangement there would not be enough of the smaller clusters to form a gel.

The limiting aluminum-silicon ratio of 1 to 2 for gelatinization in 3-dimensional silicate structures is the same as the resistance limit to attack found by Gordon and Wichers (see preceding abstract) for plagioclase feldspars heated with acid in sealed tubes. This ratio may be considered a resistance limit for an aluminum-silicon solid solution series, with a three-dimensional structure—a limit arrived at indirectly, by using different individual minerals to represent the various aluminum-silicon ratios. As predicted by Tammann, the structure can have a sharp resistance limit to attack only if the two kinds of atoms are symmetrically distributed in the structure.

This study is described in Contributions to Geochemistry, 1942–45, U. S. Geol. Surv. Bull. 950 (in press).

A. J. Bodenlos: *Structural control of the magnesite vein system in the Red Mountain district, Calif.* The Red Mountain district is on the border of Santa Clara and Stanislaus Counties, Calif., 31 miles southeast of Livermore. The magnesite deposits are in an ultrabasic intrusive body consisting chiefly of peridotite and dunite. There are five deposits in the area, the two largest being operated by the Western Mine. The magnesite is a vein mineral, deposited in premagnesite serpentinized shear and crush zones. Throughout mineralization the sites of mineral deposition have been closely controlled by structural features, as shown by: limitation of the large deposits to serpentinized shear and crush zones; localization of ore bodies within the shear and crush zones; and localization of high-grade shoots within ore bodies. The length and width of ore bodies are most variable, but the vertical extent is limited, rarely exceeding 400 feet in depth. Postmagnesite minerals, including chalcedony, opal, hydrated magnesium silicates, dolomite, and calcite, are deposited in the fractures produced by recurrent movement in the shear and crush zones. The magnesite is cryptocrystalline, white, and porcelanic in appearance, and was deposited mainly as nodular bodies replacing serpentine and also as fissure-filling in open fractures. Magnesite at Red Mountain is considered to have been deposited near the surface from low-temperature hypogene solutions.

626TH MEETING

The 626th meeting of the Society was held at the Cosmos Club, February 14, 1945, President L. W. Currier presiding.

Program.—G. H. Espenshade: *Tungsten deposits in Vance County, N. C., and Mecklenburg County, Va.*

M. Fleischer, S. K. Neuschel, and J. M. Axelrod: *Occurrence of tungsten and vanadium in manganese oxide minerals and ores.* The occurrence of tungsten in manganese oxide ores was first noted by Penrose in 1890 and since has been discussed by several authors. Vanadium has been reported in four analyses of manganese oxides. New analyses in the Chemical Laboratory of the Federal Geological Survey have shown that these elements occur commonly in manganese oxide ores, especially in those from the southwestern United States. Over 50 new occurrences have been noted, and many more will doubtless be found by systematic chemical testing.

In some deposits the tungsten and vanadium content of the ore varies directly with the manganese content, indicating that the tungsten and vanadium are in the manganese-oxide mineral. This is not true of a few deposits, including that at Golconda, Nev. X-ray study and chemical analysis show that tungsten and vanadium occur most frequently in manganese oxides that contain barium. Over three-fourths of the tungsten-bearing samples studied are the barium manganate psilomelane. Over two-thirds of the vanadium-bearing samples studied are either psilomelane or hollandite.

No generalization can yet be made as to the origin of the tungsten-bearing and vanadium-bearing manganese oxide ores. Many are of hydrothermal origin, but some appear to be secondary.

T. G. PAYNE: *Stratigraphic and structural features, lower Matanuska Valley coal field, Alaska.* High-volatile bituminous coal is produced from a Tertiary sequence. The sequence, about 6,000 feet thick, is subdivided into four parts, in ascending order: (1) 2,500 feet of alternating beds of sandstone, finer clastics, and some coal, mostly nonminable, (2) 600 feet of conglomerate, in two facies derived from different source areas, interbedded with arkosic sandstone, (3) 1,200 feet of coal measures, and (4) 1,700 feet of conglomerate and sandstone. These parts indicate alternating periods of weak and strong orogenic movements. Second-order cycles in the coal measures began with dominance of river sedimentation forming sandstone, containing channel conglomerates locally at the base, grading upward into flood-plain silts and silty clays containing a few widely spaced coal beds. After this, relative quiescence led to long-sustained regional swamp and stagnant-lake conditions forming alternating beds of minable coal, bone, claystone, and intermediate types. Relative uplift of the source area, with increased stream gradients, started a repetition of the cycle.

Stratigraphic intervals change in thickness laterally, as a result of differential compaction of sediments having marked lateral textural differences. Amount of compaction is evaluated to determine original sedimentational thickness used in correlation.

Mines are at both ends and along the north limb of a canoe-shaped syncline cut by two sets of transverse faults of horizontal displacement. An underthrust strike fault coincides with an area of tight subsidiary folding on part of the north limb.

627TH MEETING

The 627th meeting of the Society was held of the Cosmos Club, February 28, 1945, President L. W. CURRIER presiding.

Informal communication.—L. HENBEST reported on blasted limestone near Jemez Springs, N. Mex.

Program.—J. F. MCALLISTER: *Geology of quicksilver deposits in Chile.*

G. C. HARDIN, JR.: *Fluorspar deposits of the Babb fault system, Ky.*

D. E. WHITE: *Localization of the antimony deposits of Mexico.* Most of the world's antimony deposits seem closely related to the circum-Pacific belts of Tertiary and Quaternary vulcanism and diastrophism. Nearly all the Mexican production, which is about 20 percent of the world total, is from a belt 1,400 miles long by 10 to 100 miles wide, in the pre-Tertiary rocks adjacent to the northeastern border and ends of Mexico's large area of Tertiary lavas. The antimony deposits are probably related to the Tertiary volcanic activity, though possibly less closely than most of the tin and quicksilver deposits.

The antimony deposits are largely in limestone, but some are in other types of rocks. The deposits in limestone are accompanied by silicification and locally by replacement by clay minerals; solution cavities are common. The original ore mineral was stibnite, that is generally oxidized; deposits in limestone commonly carry small amounts of mercury.

The dominant structural controls are faults, fractures, and anticlinal axes; chemical control may be important. In the three most productive districts, the ore is near contacts of limestone with overlying shale, adjacent to the feeding channels. In contrast, in most other districts in limestone, the shale is lacking. Six major districts are described; in one the ore is probably related genetically to the source of the associated quartz prophyry.

Mining has not gone below a depth of 600 feet, because of the relatively low value of the ore, and the horizontal control of the ore bodies by structure or lithology. The grade of the ore may also be related to the surface, but evidence is lacking. Wherever favorable structure exists, however, the deposits undoubtedly extend below the depths of present mining.

628TH MEETING

The 628th meeting of the Society was held at the Cosmos Club, March 14, 1945, President L. W. CURRIER presiding.

Program.—H. T. U. SMITH: *Rock streams in the Blue Ridge.* Bare, streamlike accumulations of boulders along valley bottoms occur at widely separated localities along the Blue Ridge from southern Pennsylvania to West Virginia. The boulders are loosely packed, unsorted, heterogeneous in size and shape, and range up to about 12 feet in length. The sound of running water beneath the surface is audible. The accumulations are up to 1,800 feet in length and 100 feet in width. Surface gradient is generally 3° to 5°. The boulders are of quartzite derived from neighboring slopes and

ridges. They are now lichen-covered, are undergoing disintegration in place, and show no evidence of appreciable present-day movement. The rock streams appear to be "fossil" forms, and are best explained as a product of widespread movement of frost-riven blocks down valley slopes by solifluction under periglacial conditions of Pleistocene time, with subsequent localized removal of interstitial material by running water. This explanation applies also to the boulder-choked valleys and subdued, overgrown talus slopes which are more widespread in the area.

L. HENBEST: *Correlation of the marine Pennsylvanian rocks of northern New Mexico and western Colorado.* The lower limestone member of the Sandia formation, in the southern Sangre de Cristo Range, seemingly unfossiliferous and formerly classed as Pennsylvanian, proves to contain *Endothyra baileyi* (Hall), a Mississippian foraminifer characteristic of the Leadville limestone. This member, also present locally in the Sandia Range, resembles the Leadville of the San Juan Mountains and extends the Mississippian 200 miles southward. Pennsylvanian deposition began with terrestrial clastics on a deeply weathered, uneven surface at many widely distributed localties. These clastics range in age from Springer to Morrow and correlate with the intensely red Molas formation. An extensive marine invasion of Morrow age is indicated by a wide distribution of the *Millerella* fauna. *Millerella* characterizes the Glen Eyrie shale member of the Fountain formation; part of the Belden shale member of the Battle Mountain formation of Brill at Glenwood Springs and Salida; basal Hermosa, subsurface in San Juan County, N. Mex.; and the lowest Pennsylvanian limestone beds in Moffat County, Colo., and in adjacent parts of Utah. *Fusulinella* faunas (Atoka age) characterize the basal 100 feet of the Hermosa formation, San Juan Mountains, and a prominently developed zone in northwestern Colorado and adjacent Utah. They are present in the Crested Butte area, San Juan County, N. Mex. (Hermosa formation), Sierra Nacimiento (Madera formation), Sandia Range (Sandia (?) formation), etc. *Fusulina-Wedekindellina* faunas (lower Des Moines age), characterize the most widely and prominently developed marine zone in this province. They occur in the Robinson limestone of Emmons, the upper McCoy formation of Roth, the middle and upper type Hermosa formation and in La Veta Pass and the southern Sangre de Cristo Range, Sandia Range, Manzano Range, Sierra Nacimiento, and northwestern Colorado and adjacent Utah. The *Fusulina girtyi* zone (middle Des Moines) is generally lacking. The apparently uppermost Des Moines species of *Fusulina* are found so far only in the Sierra Nacimiento and in Juniper and Cross Mountains in Moffat County, Colo. The zones of *Millerella*, *Fusulinella*, and *Fusulina-Wedekindellina* are well displayed in Juniper and Cross Mountains, but the rocks of equivalent age become more clastic and less fossiliferous westward. If rocks of Missouri or Virgil age are present in the western Colorado uplifts they are generally represented by redbeds and clastics barren of Fusulinidae.

G. W. STOSE: *A description of the geologic map of South America.* A hand-colored first draft of the geologic map of South America, compiled under the auspices of the Geological Society of America, the American Geographical Society, and the U. S. Geological Survey, to be published as a special paper of the Geological Society of America, was presented. It was pointed out that the Archean complex and overlying Algonkian sediments in the Brazilian shield are comparable to pre-Cambrian rocks of the Appalachians of the United States, that the Gondwana series of South America culminates in redbeds and vast basalt flows of late Triassic age comparable to the Newark series of the Appalachians, that late Carboniferous granites and Paleozoic rocks in eastern Colombia may be the southward extension of Appalachian structures in the United States, and that the late Cretaceous to early Tertiary granitic intrusions of the Sierras are continuous with those in the Andes from Colombia to Patagonia.

629TH MEETING

The 629th meeting of the Society was held at the Cosmos Club, March 28, 1945, President L. W. CURRIER presiding.

Program.—C. WAHRHAFTIG: *Preliminary report on the physiographic history of part of the Alaska Range.* The results of field studies in connection with the investigation of coal deposits in the Alaska Range and of studies of aerial photographs indicate that the late Ter-

tiary and Quaternary geology of the Alaska Range can be summarized as follows: First, uplift of mid-Tertiary mountains, faulting and folding the coal-bearing sediments, resulting in the deposition and later deformation of 5,000 feet of continental Nenana gravel. Second, reduction of at least part of these mountains to a nearly level surface. Third, warping of this surface along east-west axes. The Alaska Range was uplifted, and the Tanana flats to the north depressed. The history of this warping is evidenced by numerous superimposed streams and excellently preserved terraces and erosion surfaces. Glaciers advanced north from the Alaska Range on two occasions; the surface on which the early advance took place is at the level of the Nenana River at the northern border of the mountains, and is 2,300 feet above the river 20 miles to the south. The terminal moraine of the latest (Wisconsin) ice advance is preserved at Healy on a terrace 400 feet above the Nenana River. This terrace merges with the level of the river 20 miles north. What appears to have been a dome subsidiary to the main uplift of the Alaska Range has produced the Kantishna Hills. Doming of these hills has forced the drainage from the Alaska Range around the southwest end of the Kantishna Hills. Sediment formation in a manner similar to that prevailing in arid regions appears to have contributed to the development of the various terraces and surfaces as much as lateral planation of the major streams.

C. P. Ross and J. D. FORRESTER: *The new geologic map of Idaho.* The recently compiled geologic map of Idaho is expected to be ready to go to the printer in April 1945. Although a number of small-scale geologic maps of the state have appeared, this is the first colored map in comparable detail that has yet been prepared for publication. It should be the forerunner of others.

The map shows the Idaho batholith, and other intrusive bodies, the wide expanses of Belt rocks, the highly deformed Paleozoic and Mesozoic strata, and the extensive and varied cover of Tertiary and later rocks. The famous Coeur d'Alene region, marked on the map by a complex of faults, continues to be the most productive mining area in the state but during World War II notable contributions in tungsten, quicksilver, antimony and other metals have been made by mines farther south. The Phosphoria formation, one of the map units conspicuous in the southeastern part of the state, has long been famous for its phosphate reserves and more recently for its vanadium.

The geologic map, accompanied by structure sections and a bibliographic index map, is to be published under a cooperative agreement between the U. S. Geological Survey and the Idaho Bureau of Mines and Geology.

G. A. COOPER: *Stratigraphy of the Caborca area, northwestern Sonora, Mexico.*

630TH MEETING

The 630th meeting of the Society was held at the Cosmos Club, April 11, 1945, Vice-president A. A. BAKER presiding.

Program.—P. B. KING: *Tectonic map of the United States.* A tectonic map of the United States was published in 1944 by the American Association of Petroleum Geologists. A tectonic map is one that depicts by symbols and patterns the geologic structure—that is, the lay of the rock strata, their folds and dislocations, and the position of volcanoes, salt domes, and many other features. The tectonic map of the United States is the result of long planning and cooperative endeavor by American geologists and their organizations. It was compiled by the Committee on Tectonics of the National Research Council. The map is based in part upon published sources, such as the numerous maps issued by the Federal Geological Survey. In addition, a large amount of unpublished material was furnished by petroleum geologists. On the map, the structure of the gently tilted rocks of the central interior region and the coastal plains is represented by contour lines. To a large extent these contours are derived from data obtained in the drilling of numerous wells put down in the search for oil and gas. The tectonic map is of considerable academic interest, but it is also being used by geologists who are searching for new productive provinces for petroleum and for ore deposits.

A. H. HOWLAND: *Petrology of the Society Islands.*

S. S. NYE: *Orogeny of the Mexican Plateau and its relation to ore, oil, and ground water.* The search for ground-water for the irrigation of guayule in the basins near Torreon[1] necessitated a consideration of the origin of the

[1] By an employee of the Emergency Rubber Project, U. S. Forest Service.

basins. The conclusion was reached that the excavation of the basins by stream erosion is impossible and that the basins are the product of two major periods of down-faulting and filling with detrital material. The following hypothesis was offered:

Beginning in late Cretaceous time a great body of magma was formed beneath the entire Mexican plateau through the constant addition of heat. Expansive forces resulting from the heating of the magma lifted the plateau. Fractures formed along the south and west sides permitted the extrusion of lavas. The subsequent loss of temperature and pressure within the magma chamber resulted in the structural failure of its roof and collapse of the basins. Deformation of the strata in the Eastern Sierra Madre and south of the Parras Basin resulted from sliding and falling of these strata on a pre-Jurassic surface. High temperature ore deposits occur in fractures formed during the lift of the plateau, moderate temperature deposits in fractures formed during the first collapse, and low temperature deposits in the fractures formed during the second collapse. Oil structures within the plateau were destroyed; mild deformation on the coastal plains permitted the later accumulation of oil. Fracturing during the uplift and basin faultings provided initial reservoir and channel openings for the large springs. The first basin fill, derived largely from shales, contains little, if any, high yielding water-bearing material. Water for large-scale irrigation should be sought for in the secondary basins where there are large amounts of unconsolidated gravel and sand.

631ST MEETING

The 631st meeting of the Society was held at the Cosmos Club, October 24, 1945, President L. W. CURRIER presiding.

Program.—MARIE L. LINDBERG: *Bromine in carnallite and sylvite.* Both carnallite and sylvite from Eddy County, N. Mex., contain 0.1 percent of bromine. The bromine content of these minerals from Grand County, Utah, is three times as great. No bromine was detected in halite, polyhalite, langbeinite, or anhydrite from New Mexico. Iodine was not detected in any of these minerals. On the basis of the bromine content of the sylvite from New Mexico, it is calculated that 7,000 tons of bromine were present in potash salts mined from the Permian Basin during the period 1931 to 1945.

H. T. U. SMITH: *Giant glacial furrows on northwest Canada.* In the Mackenzie Valley area west of Great Bear Lake, many ridges and mountain slopes are cut by glacial grooves on a scale far larger than previously recorded. Individual grooves range up to about 100 feet in depth and more than a mile in length. The grooves are essentially straight, parallel, and closely spaced, forming a characteristic ridge-and-trough topography. They occur in zones showing the influence of both topographic exposure and differential erodibility of the bedrock. The orientation of the grooves is indifferent to structural trends and to drainage lines. The alignment of grooves in the several zones falls into a systematic pattern recording the advance of a continental ice sheet northwest along the Mackenzie Valley.

J. B. MERTIE, JR.: *A review: "Atomic Energy for Military Purposes," by Henry D. Smyth.*

632D MEETING

The 632d meeting of the Society was held at the Cosmos Club, November 14, 1945, President L. W. CURRIER presiding.

Program.—C. B. HUNT: *Military geology.*

633D MEETING

The 633d meeting of the Society was held at the Cosmos Club, December 12, 1945, Secretary J. VAN N. DORR, 2d, presiding.

Program.—Presidential address by L. W. CURRIER: *"Granitization" as a regional metamorphic process in New England.*

53D ANNUAL MEETING

The 53d Annual meeting was held immediately following the 633d regular meeting. The reports of the meeting secretary, treasurer, and auditing committee were read and approved. Officers for the year 1946 were then elected:

President: W. H. BRADLEY
Vice-presidents: W. F. FOSHAG and J. C. REED
Secretary (2 years): MEDORA H. KRIEGER
Treasurer: M. K. CARRON
Members-at-large of the Council: ALICE ALLEN, J. R. BALSLEY, W. H. HASS, A. H. KOSCHMANN, and V. E. MCKELVEY.

The Society nominated L. W. CURRIER to be a vice-president of the Washington Academy of Sciences for the year 1946.

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JOURNAL
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VOLUME 36 MAY 15, 1946 No. 5

CULTURAL ANTHROPOLOGY.—*An application of the theory of themes in culture.*[1]

MORRIS EDWARD OPLER, Fellow of the John Simon Guggenheim Foundation. (Communicated by WILLIAM N. FENTON.)

In a paper previously published it was suggested that dynamic affirmations called themes could profitably be employed as a point of departure in analyzing or interpreting a culture or a particular round of life. A theme was there defined as "a postulate or position, declared or implied, and usually controlling behavior or stimulating activity, which is tacitly approved or openly promoted in a society."[2] In that article were discussed the actualizations or "expressions" of the theme in conduct and belief, the types of expression that are likely to be found, the clues to the relative importance of themes, the limiting factors that ordinarily prevent a single theme from dominating the culture or disrupting the cultural equilibrium, and the structure that results from the balance and interplay of themes. The examples offered did not constitute an ordered review of the themal system of any particular culture, however, but were chosen primarily to illuminate the definitions and the theoretical points to be made. In the present paper I propose to list, illustrate, and briefly discuss all the themes I have been able to identify in a given culture.[3] The culture I shall analyze in this manner (and this is a quite arbitrary choice) is that of the Lipan Apache Indians of the American Southwest.

Before introducing the themes of Lipan culture and the supporting evidence that seems to me to validate them, it may be helpful to explain how they were determined. After the information had been obtained in the field, the notebooks were read and headings were supplied to guide the typist. Before the typed materials were filed under conventional categories they were proofread and corrected. Large sections of the data have been consulted from time to time in the preparation of articles and monographs. Thus, constant handling of the material over a long period had made me thoroughly familiar with it and increasingly conscious of the principal Lipan doctrines and postulates that were affirmed. When I decided to test the theory of themes by applying it to this particular body of material, I again gave the entire set of notes a close and uninterrupted reading so that I might appreciate the extensions and ramifications of any theme recognized in an early phase of the survey. It was only after this that I systematically worked through the data, brought together the items of belief and behavior that seemed to be inspired by a common affirmation or incentive, and endeavored to express the ruling and unifying doctrine as a statement that I have called a theme. I had no idea how many themes would result from this treatment. I could not foresee what proportion of the material would be found to be an expression of one or another of the themes and so would be absorbed and utilized by means of this method. The approach has been thoroughly experimental and, in terms of execution, largely inductive.

In a description of a culture in terms of

[1] Received March 1, 1946.

[2] OPLER, *Themes as dynamic forces in culture*, p. 198.

[3] The opportunity to perfect the method, organize the material, and write this paper was made possible by a John Simon Guggenheim Fellowship. I am grateful to Commander A. H. Leighton, Medical Corps, U.S.N.R., Dr. Dorothea C. Leighton, Dr. William H. Kelly, and Dr. William N. Fenton, who read this article in manuscript, for helpful comments and criticisms.

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themes, particularly in an outline summary account such as this, the emphasis is bound to be upon ideology, values, and stimuli to activity rather than upon an inventory of techniques of manufacture and material possessions. By the very definition of a theme, the point of departure must be the warm, normative, subjective aspects of the culture rather than the practical, objective facets that Merton, following Alfred Weber and R. M. MacIver, has given the technical term "civilization."[4] The apparent slighting of items relating to geographical setting, technology, and material culture may disturb those who are used to the orthodox ethnographic tradition and who expect to learn early in any study of a native people what plants they use, how they tan skins, and how they fashion weapons. Actually, a full exposition based on the themal approach would provide the details of material culture and technical proficiency, though, to my mind, this is not its primary task. For instance, a complete discussion of the moral-social virtue industry (theme 17) would necessarily indicate what industrious men and women are trained to do and would consequently offer a clear picture of the division of labor and the nature of the daily tasks.

One other introductory comment may be in order. Because themes are generalizations from many particulars and because many of them have an abstract and philosophical flavor, they may be confused by some with ideal rather than actualized or expected patterns of behavior. It must therefore be emphasized again that the themes listed below are distilled from the details of the culture as it functioned or is alleged to have functioned and therefore represent requirements and guides to action and not merely pious hopes.

Theme 1. The elements of the universe are actually or potentially animate and personified

The traditional "history" of the Lipan begins in an underworld at a time when animals, birds, plants, and rocks were also people and all shared a universal language. The elements of the natural world did not assume their present forms until the "people" of the underworld had emerged and were traveling sunwise around the surface of the world. Then it was, for instance, that the Juniper People halted their journey at a certain spot and the gay necklaces of green beads they wore became the juniper berries that the Lipan have gathered for food ever since. The earth to which the people of the emergence came is described as a woman, and those who live upon her body are considered to be her children.[5] Large rocks are her teeth. Earthquakes occur when she becomes excited, when she is dissatisfied with the weather.

The sun and the moon, too, traveled for a time with the people of the emergence. Male characteristics are attributed to the sun, and, in his personified guise, he is identified with Enemy Slayer, the culture hero. The moon is most often thought of as a woman and is associated with Changing Woman, the culture heroine and the mother of the culture hero. Before they left the people of the emergence, these two promised that they would always keep moving in the heavens, guiding and watching over those with whom they had journeyed. The sun, in particular, is a model of industry and virtue. He never tires of telling earthlings, "Do not lie in bed; get up when I do." The morning glow is the sign that he is mixing his paints. Early in the morning he daubs his face with red ochre and starts out. In summer he travels closer to the earth, in winter farther away; therefore winter is the most dangerous as well as the most inclement of the seasons. In summer he travels slowly, causing the days to be long and giving the plants which sustain man a chance to grow. But if the people are practicing sorcery and courting evil, Sun grows angry and it becomes unseasonably hot or cold. Should the misbehavior

[4] MERTON, *Civilization and culture*. While the distinction is an extremely helpful one, I am not enthusiastic over the use of the term "civilization" in this sense.

[5] Very few Lipan survive today, and many traits of the aboriginal culture are no longer practiced. To prevent confusion and to obviate the necessity for constant change of tense, however, the historical present will be used throughout in describing Lipan culture.

persist, the sun, who hates sorcery above all things, hides his face and an eclipse occurs. Then the old people bring the pegs which are used to stake out hides and shake them together so that the sun's wrath will not be felt close by.

In the beginning, when all objects of the world were animate and personified, the fruit and old age were placed in the care of Walking Rock. It was he who prayed to the Thunder People to bring rain and to allow the fruit to ripen; it was he who first daubed white clay on the heads of people and thus brought gray hair and old age into being.

The Lightning (or Thunder) People are winged sky beings who are, unfortunately, easily aroused to jealousy and anger. The greatest danger, however, is from their children, who are inclined to be mischievous and to shoot their arrows (lightning) carelessly. Not only is Lightning animate, but it is essential to the animation of man. There is lightning within every human being. Wind, too, enters the body by way of the throat at birth, and life lasts only as long as these two vital qualities remain.

Peyote is a small cactus with narcotic properties which is found along the Rio Grande watershed in Texas and northern Mexico. When its crown, the "peyote button," is cut off and chewed, exhilaration and color visions result. A widespread religious cult has grown up around the use of this plant. In each Lipan peyote ceremony, a large "button" is placed back of the fire and is closely watched by the ceremonialist in charge. This "chief peyote," I was assured by Lipan, can see and understand better than a man and functions to reveal and to prevent wrong-doing and evil thought. By means of this plant the pious can come into contact with the Peyote People who have meetings of their own, who eat each other with impunity and who grant power and ceremony to those who seek to know their ways well.

In their own settings, animals are described as having human sensibilities. According to one account, a Lipan woman finds shelter from a storm in a bear's den. The parent bears are absent when she arrives, but, because she treats the cubs with affection, the elders spare her life and ultimately guide her back to her home. Nevertheless, while she is with them, the bears make her wash in yucca root suds, for the human odor she exudes is most obnoxious to them. This is a neat reversal of the objection of Lipan to various animal odors.

Often what appears to be only a bird may actually be the alternative form of a being that controls the means to wealth and prestige. The cowbird, for example, is associated with the capture and taming of wild horses. For the benefit of one to whom the acquisition of and control over horses is a religious as well as a secular quest, Cowbird may assume the form of a little man with quirt in hand, clinging to the neck of the stallion that runs at the head of the herd. Should the quirt fall to the ground during pursuit, it is recovered by the Lipan and prayed to reverently. As likely as not, a vision experience and a power grant will result from such an encounter.

All this is but a sampling from the rich store of tale and belief emphasizing the animate and human attributes of objects and beings of the earth and skies. Consequently, in terms of interest and desire, it is a small, intimate universe in which the Lipan dwell. Consciousness, human characteristics, and concern for the people of earth bring the mightiest and most remote elements close. On the other hand, the familiar, the small, and the inert are magnified in importance by the tradition that they were once powerful and alive and may become so again to the discerning. Vitality, power, animation are not formally fixed and immutable. They are like beams of light that shine now here, now there. The feelings, attitudes, and place of all things must be considered, for to the very end of his days the Lipan does not know what may yet succor him and what may be instrumental in his undoing.

Theme 2. The universe is pervaded by diffuse supernatural power, which may become specific for those psychologically prepared to receive it

The objects, forces, and beings of the Lipan world usually become animate or

personified in order to aid the deserving or to punish the erring. The aid offered a human being may be for the occasion only or it may consist in the granting of a ceremony which insures supernatural help in recurring crises. A ceremony properly performed is a claim on the help of the source from which it came. Therefore particular ceremonies are extremely useful for specific tasks or occasions. A shaman who has a power grant and a ceremony from the buffalo, for instance, conducts his ritual before a buffalo hunt. A person who knows a ceremony from the horse or from some creature associated with the horse, such as the cowbird, conducts a curing rite when someone has fallen from a horse or requires his good luck with horses restored. Thus supernatural power is so funneled to the human scene that it offers assistance and relief in most contexts within the range of Lipan experience. Accordingly, appeals to supernatural power are an indispensable adjunct to any important undertaking.

In terms of their interests and needs Lipans constantly seek to tap this vast reservoir of supernatural power. One man, for example, felt that he could learn "something to live by" from peyote. He gathered the plants and prepared the peyote "buttons." Then he cleansed himself in suds prepared from yucca root and built a brush shelter. Next he rolled a cigarette and blew smoke to the cardinal directions, beginning with the east and moving sunwise. He then sprinkled piñon pollen on one of the peyote "buttons," held it to the directions, and picked it up and laid it down four times before chewing it. He did this with four peyote "buttons" and repeated the ritual for four nights. On the fourth night he placed peyote under his pillow. That night, in the vision he sought, he was touched on the side of the head four times. He heard voices and rose to greet a man and a woman who had come to guide him to a "power home." They led him into a little hill, and, though he was young, he was courageous and followed them without fear. Once inside, he bravely asked the supernaturals who lived there for the "highest power" that can be obtained through peyote. He was granted ceremonial knowledge which he used to good advantage against sickness and enemies, and he became a well-known leader of the peyote ritual.

Another Lipan liked nothing better than to pursue and capture wild horses. On one of his expeditions, as he marveled at the ability of the wild stock to elude him, he saw the author of his difficulties, a little man (Cowbird) who clung to the fleetest stallion and led the herd to safety. In the spirited chase the little man and the horses again escaped but not before Cowbird had dropped the little quirt he had been flourishing. The Lipan recovered this and placed it under his pillow. Cowbird missed his whip, thought constantly of his loss, and was therefore drawn to the intrepid Lipan. He appeared to the Lipan in dreams and visions and taught him prayers and songs. Thereafter this man was most successful in raising good horses and performed a powerful ceremony over those who had any mishap with these animals.

These are only two of the many examples that could be cited to indicate the Lipan belief in supernatural power, which becomes differentiated and manifest as it reaches man through various media. This does not mean that power quests always succeed or that the claims of individuals to supernatural power are always accepted; there are frank admissions of failure to obtain desired supernatural help and considerable scepticism concerning the authenticity of the representations of particular individuals. But belief in the reality of supernatural power and in the ability of Lipan men and women to receive its benefits and warnings is a fundamental theme of the culture and is expressed in the countless activities, possessions, and exchanges that enter into the ritual round.

Theme 3. Life and the life forces are constantly threatened by evil and danger

Lipan reaction and behavior are marked by a strong consciousness of the evils and dangers that beset men. In fact, many of the activities to which the Lipan devote an enormous amount of energy and thought

are protective in nature. The recognition of evil and danger is woven into the very fabric of sacred legend and the Lipan world view. When the Lipan emerged from the underworld they were greeted by hostile monsters as well as by kindly supernaturals. A Monster Buffalo, a Monster Owl, and Monster Eagles were among those who had to be vanquished before the earth was inhabitable for man. Another bird of "evil influence" is the raven, who willed that there should be death, who set himself against the life forces, and is responsible even today for much sickness and contamination. The ghosts of the dead seek to draw their relatives to them at an untimely age, and contact with corpses or graves may give them their opportunity to accomplish this. Malicious and envious tribesmen (witches) may use supernatural power for evil rather than for good ends; power itself, when personified, may make suggestions that only witches would gratify. Water Monsters wait in rivers and water holes to seize and drown the unwary man or horse. Any contact with a snake or even with the spot where a snake has been can cause serious affliction. The Thunder or Lightning People are easily moved to jealousy, anger, and retaliation, and their children are "mean" and mischievous, often "shooting thunder flints" (sending lightning) without provocation. Even dreams may be a frightening signal of sickness or death; dreams of fire, of flood, of the dead, or of witches are particularly disconcerting.

In this manner the Lipan have personified the general insecurities they feel and the inimical forces they can not name or can not directly control. But they have a vivid appreciation of the more explicit and observable dangers, too, and a constant uneasiness about them. The likelihood of injuries during the realistic slingshot and arrow battles by means of which the youths are trained is freely admitted, but the practice is explained with the simple comment, "When there are many enemies the boys have to be trained to be active." In a story told to the boys to impress them with the need for being wary of all strangers, "Foolish People" are described who meet a first group of Comanches on a friendly basis and later, without careful investigation, erroneously assume that a second group is approaching in the same frame of mind.

The general tension and anxiety the Lipan feel is perhaps illustrated by the following incident. In order to tease his sleeping wife an old man discharged his grandson's tamped popgun near her head. Unfortunately the old woman was dreaming that she and her relatives were being pursued by Mexican soldiers. In her dream the noise of the toy became a Mexican gun discharged at her head. She kicked and writhed so long and was so hard to arouse from sleep that her husband was seriously alarmed.

Theme 4. Security and harmony are attained largely through the conquest of fear and danger and through self-discipline

If the Lipan are acutely conscious of the evils and dangers that beset them, it must also be said that they do not quail from pitting themselves sturdily against their seen and unseen foes. Because their enemies are strong and remorseless, they train their young men to meet them on equal terms. They take the view that from the beginning life has been a series of hazards to be overcome. It was Enemy Slayer, the Lipan culture hero and exemplar, who, immediately after the emergence, slew the man-eating monsters in a series of marvelous adventures. In those early days the large and evil animals challenged the smaller, kindlier ones to a contest of "hidden ball." A victory for the large animals would have meant perpetual darkness for mankind. By their shouts and threats the protagonists of unending night attempted to frighten and weaken their opponents, but the small animals persisted and finally saw the sun rise on their triumph. Since that time man has had to war relentlessly against the seemingly superior forces that seek to intimidate and overawe him.

The theme of the conquest of fear and weakness is often found in ceremonial contexts. Supernatural power favors those

who are not easily terrified. In visions, when persons who seek ceremony are led into power homes, fearsome animals and obstacles usually bar the way. The ceremonies, or at least the most important power grants, ultimately are gained by those who show no signs of fear or doubt at this time. Peyote is said to test its adherents severely in this manner. Some, when they first chew peyote, are said to see frightening visions. If they become alarmed and leave the place of meeting in panic, the unpleasant episodes they envision may occur. The proper course is to remain, to force unpleasant thoughts aside, and to continue to eat peyote until desirable visions appear.

A peyote story relates how four men eat the plant in order to find out more about its ways. Old Man Peyote (the personification of the peyote plant) enters and fells one of the four with a savage blow on the head. While the spirit of the victim is being led by Old Man Peyote to the power home to learn more about the ritual uses of the plant, two of his companions, frightened at the blood and the presence of the body, run out of the tipi. The third man understands what is occurring, however, and persuades his companions to return and continue the ceremony for four days. By this means the unconscious man is brought to life again and additional knowledge is gained. Had all three men broken off the ritual in fright, their stricken friend would have remained dead.

This fierce determination to conquer fear and to overcome danger has resulted in a cult of bravery that has many expressions. Lipan children allow pith from the inside of the sunflower stalk to burn to ash on their outstretched arms in order to demonstrate their courage. Or they touch burning brands to one another's fingernails, in the same spirit. Another test is to drop a turtle in hot coals, and to use the bare hands to keep it covered. If the animal escapes from the embers, the child is said to be a coward who will run away from danger. Obviously it takes a brave youngster to continue to heap hot coals on with his bare hands.

Fearlessness ranks high on the scale of Lipan social virtues, as we shall point out later. There is a whole cycle of stories about a fearless man who overcomes a buffalo bull, puts a fierce peccary to flight, insults a Mexican army officer, and even kicks a snake—though he becomes ill as a result of this last rash act. A favorite story recounts the deed of a small group of Lipan men who lead a strong raiding party of the enemy away from the camps and out into the plains. There they face the foe and beat him off.

The requirements of the manly code invade the social realm as well. A badly deceived husband finds his wife and her lover sleeping together. He shoots an arrow into the man but before he can kill the woman she wakes and pleads for her life. He feels compassion and affection for his erring wife surge over him, but with a determined effort, he conquers his "weakness" and executes her too.

Theme 5. The mastery of life forces which maintains security is a result of agreement and compact and consequently imposes restraints and obligations

In the Lipan view the struggle against evil and danger is an interminable one in which the hostile forces are at best controlled and modified rather than eliminated. Partial victories ending in truce and agreement are the rule; a disregard of the means by which evil is held in leash may loose misfortune upon the entire community again. The margin by which man maintains control over his destiny is a narrow one; he must constantly pacify elements of his world that would otherwise turn against him and upset the precarious favorable balance he has achieved. And so man must adhere rigorously to his obligations, ritual and social. In order to keep on even terms with men and supernaturals he must exercise and enforce the restraints that prevent breaches of faith and conduct. He remains aware of his insecurity and modestly seeks to rally all beings and forces, great and small, to his cause.

This conception of the relation of man to his world is presented time and again in the most important Lipan traditions. In the tale of the slaying of the monsters by the culture hero, for example, Enemy

Slayer, though he was mighty, gave to mankind an example in humility by requesting the aid of the tiny gopher in conquering the Monster Buffalo. When this monster had been vanquished it was allowed to live on in reduced size on condition that it would permit mankind to use its flesh and hide. Though the buffalo assented, it, too, exacted conditions. From these are derived the rules and ritual for hunting and butchering the buffalo. When these are violated, Buffalo has the right to hide from man and to withhold its flesh and skins.

The antelope, eagle, and other animals that originally preyed on man were subdued and agreed to cooperate with mankind under roughly similar conditions. Their continued submission and good will are likewise dependent upon the self-discipline and adherence to covenant that mankind shows.

It is no different in regard to the horse. The faithful service and even the good health of the horse are one side of a bargain that men, too, must heed. Thus, children are taught that they should not throw saddle blankets around, that they should not strike horses on the head with a whip, and that they must not get in a saddle when it is in a tree or is lying on the ground. If these cautions are disregarded the horses of the family will suddenly acquire sores on their backs, or good horses will mysteriously "go down" in a few days.

Deer, too, can withhold their favors from those who fail to treat their flesh and hides with the conventional respect. The deer, who have the wind for their messenger, are always aware of the position of the hunter and surrender themselves only when they see fit to do so. Deer are under no obligation to reveal themselves to individuals who fail to show due respect for the rules and observances of the hunt.

Many other observances and restrictions are followed because they are man's part of a covenant. For that reason the unused part of a plant gathered for medicinal purposes is put back in the ground. The plant is willing to give of its root but requires a respectful handling of its leaves in return. The supernaturals perfected the sweat lodge for man and gave rules concerning its proper use, but the person who erects one without knowing the appropriate songs and prayers will smother to death. The masked dancers can aid mankind at the time of sickness, but the efficacy of the rite is marred if someone calls the name of an impersonator. In short, there are many animals, supernaturals, and natural objects that have been forced to help mankind or that have agreed to help mankind, but they do so only at a price. Lipan who desire an ordered round of life and a minimum of insecurity agree and insist that the price be paid. Therefore this theme has become an important conservative force in Lipan culture, for few dare neglect the duties and the rites which insure an uninterrupted flow of services, sacrifices, and benefits from animals, natural forces, and the supernaturals.

Theme 6. Socially approved contacts with the supernatural must occur within the limits of a recognized ritual frame

As we have seen, the Lipan are greatly concerned over the existence and persistence of evil and danger. They recognize that men may claim benevolence falsely and that some kinds of supernatural power may even prove malefic. Therefore, while the need for supernatural help and ceremony is keenly felt, it is quite as strongly urged that traffic with the supernatural should be carried on in terms of a recognized and reassuring pattern. I know of a case of a violent conflict between two Lipan that occurred because one was asserting claims to power without recourse to the ordinary ceremonial conventions of prayer, song, and other common elements recognized as constituting a beneficent rite. The second man, who was made extremely nervous by "religious" conduct which did not invoke familiar patterns and symbols, ordered him to stop and threatened him with physical violence if he did not do so. Another person explained to me how he came to feel that a shaman, whom he at first viewed with suspicion, was really "doing only good" with his ceremony. This

practitioner sang "strong" songs, which mentioned "all the good and holy things," and he managed to crowd most of the highly respected elements of Lipan ceremonialism into his rite. When he heard and saw this, the sceptic was convinced that any procedure that depended so entirely upon symbols and references valued and accepted in Lipan religious life could not be unworthy.

As a result of this attitude, Lipan religious thought and behavior are held to a ritual frame that consists of a specific set of acts, references, and symbols, though they may be differently arranged and slightly varied according to the occasion.

In requesting a shaman to conduct his ceremony it is necessary to proffer him a cigarette or four ceremonial gifts. The gifts usually include tobacco and often suggest the nature of the ceremony desired and the shaman's source of power. Thus, a bridle may be one of the gifts of supplication in requesting a ceremony for the purpose of repairing a mishap with a horse. The smoking of a cigarette or the acceptance of the gifts indicates the shaman's willingness to act.

The shaman will probably require that the structure in which he carries on his ceremony have the door facing the most important ritual direction, east. In whatever he does there is an association of color, direction, number, and sunwise circuit. In prayer, for instance, the east is mentioned first and is referred to as black; south comes next and is blue; the circuit continues to the west, which is named yellow; fourth and last is the north, ordinarily associated with white. As this suggests, four is the Lipan sacred number; what does not happen in fours or multiples of four can hardly be of ceremonial significance.

A shaman usually begins a ceremony with the puffing of tobacco smoke to the cardinal directions in sunwise order, beginning with the east. A prayer of four parts and the singing of songs in groups of fours follows. The songs often contain numerous references to Changing Woman, the mother of the culture hero, and to Enemy Slayer, the culture hero. A drum (much less frequently a rattle) is used to accompany the singing. For some rites a fire is ceremonially kindled. At intervals the shaman uses the sacred substances and objects he has brought with him, pollen (by far the most frequently employed sacred substance), red ochre, yellow ochre, and white paint. These are sprinkled to the directions, applied to the head, face, or body of the patient or the subject, or they are touched to objects that are to be purified or sanctified. Sometimes, to indicate mutual spiritual participation in the rite and its purposes, the marking of the face or body with pollen or paint is reciprocal; the religious leader and the observers mark the patient or central figure and are marked by him in return. If the patient or subject is a woman her hair will be worn loose and flowing. In dressing or marking the patient or subject, the right side is given precedence over the left and the lower part over the top. If special clothes are prepared for a ritual they will be made of buckskin for a male and of doeskin for a female. Food eaten at a ceremony is ordinarily blessed and sprinkled with a cross of pollen. The cross, a symbol of the four directions, is often found in ritual contexts. If the food is to be eaten by the patient, a ritual feint brings it to the mouth four times before it is finally consumed.

There are still other common Lipan ceremonial objects and observances that are fitted into ceremonies whenever possible or practicable. There is much smudging and incensing to purify and to drive away evil. Sage is usually burned for such purposes. Ritual bathing for purification is practiced on occasion. If anything is to be ritually cut this is done with a flint or obsidian blade. Eagle feathers (symbolizing life and activity), abalone shell (a symbol for the north star and for those things that steadfastly guide men through life), and the "age stick" (a wooden cane, a bow, or a fire poker representing the hope of long life for the subject) are frequently in evidence. There is the constant attempt to identify the patient with persons or forces that are growing or that have already reached old age. Thus, a child is held to a one-day-old moon; a hair-cutting ceremony is deferred until the plants of spring begin to grow; or a very old person is sought to

carry on certain ceremonies for a young child. The path of successful and long life is sometimes represented in ritual by four steps to the east through which the patient or a child is led. Ritual objects which are not to be used again are placed on plants, bushes, or trees, to be "taken back" or absorbed by the "power" with which they are associated.

Theme 7. The essentials of tribal existence are fixed and ordered by events of the past, by traditional practices, or by supernatural sanction

In the Lipan view life is less an adventure than a fulfillment. There are choices and alternatives, but the existence even of these is a result of predestination rather than of man's strivings. Life and death merge into a cycle that began in the underworld of legendary times and that is finally completed when the individual returns to the underworld at the end of his earthly term. Ritual is a reenactment. The traditional rites are conducted exactly as Enemy Slayer and other protectors and protagonists of the legendary period performed them, or they are carried on precisely as the supernaturals rehearse them in the vision experience fundamental to the power grant. The lens of consciousness is so adjusted that the Lipan see their own world in extremely sharp focus and consequently discern little else; they know what to expect and what to anticipate.

Accordingly Lipan culture seems to its carriers not only to be the time-honored way but also the inevitable way. The informant who undertook to explain to me the necessity for incessant fighting and raiding expressed this view perfectly. He pointed out that sooner or later enemies would come and steal Lipan horses. Those who suffered loss would go to the chief to complain, and a pursuit party would be organized. If its members overtook the raiders a fight would ensue. Conversely, when Lipan horses became too few in number, the herd of some alien tribe would be raided. The enemy would nearly always follow and must be outdistanced or outfought. These exploits would become a challenge or a cause for revenge and would lead to a cycle of expeditions and reprisals. My informant saw no way in which this round of events could be arrested.

The Lipan speak often of a "path," "trail," or "way" of life. Thus, there are the well esteemed among them who "follow Enemy Slayer's way" or the inept who "follow Coyote's way." But whether a Lipan follows this trail or that, he is expected to remain in *some* beaten and well-recognized path. To be as foolish and fickle as Coyote is forgivable; to be aberrant in unfamiliar or unsanctioned ways is the real offense.

Great emphasis is laid upon the precedents through which norms of conduct were established and in terms of which proper behavior is rationalized. When Enemy Slayer contended against one of the monsters he sought the help of Lizard. Lizard created a path to the monster, stopping four times along the way to escape detection. By following this course without deviation and halting at the very same points, Enemy Slayer was able to reach and destroy his opponent. The lesson is patent: the past holds the clues to appropriate behavior, and it is only by the conscientious repetition of traditional ways that life's obstacles can be overcome.

It is impossible here to list all the evidence indicating that the Lipan consider their modes of activity predestined by the experiences of the supernaturals and animals of the early times. Enemy Slayer made arrows, scalped the monsters to prove to his mother that he had slain them, and in other ways established the "work" and interests of Lipan men. He created the horse and explained the rules of the horse ceremony. Then he went on raiding expeditions to obtain horses and led war parties against the enemy. Of the Lipan he said, "They must do what I have done. They must follow my way and rules." Explained an informant, "That's why the Lipan went out raiding after horses and fought their enemies when they met them." The important Lipan games (such as the woman's stave game and the hoop-and-pole game of the men) are the ones the animals of the emergence played when they first came to the upper world. Such unal-

terable realities as death, arguing and the necessity for sewing clothes are traced to the acts of Raven during the legendary period. After the first death, Owl offered to take care of the corpse and thus became associated with the dread event of death for all time.

Even the common forms of perversity are attributed to occurrences in the distant past that have served as a model for the unworthy ever since. Because of the misbehavior of Coyote, the trickster, men swear falsely on occasion, disobey those in authority, seduce their neighbors' wives, and even commit incest. Thus is sin vouched for by tradition. In practice this means that the familiar or acknowledged foibles and lapses of mankind are usually accepted philosophically and with a reasonable amount of indulgence. The Lipan are not perfectionists. They recognize many paths of life, some of them admittedly devious since the first days of mankind.

Theme 8. Within the tribal pattern freedom of choice for the individual is respected and the social importance of the individual is recognized

The importance of pattern and the emphasis of the deeds of the heroes and supernaturals of the earliest epoch do not prevent a recognition and appreciation of individual differences by the Lipan. As we have seen, it is frankly asserted that some men follow Enemy Slayer's way and some follow Coyote's example. Enemy Slayer is a mighty warrior, raider, and hunter, but it is recognized that individual Lipan men vary markedly in ability in respect to these pursuits. Changing Woman is the paragon of womanly virtues and the ideal set befor all Lipan girls, but that there are differences among women in the performance of the tasks that Changing Woman prescribed is no secret. There are a great many indications that individuality, personality differences, and variations in ability and performance are expected, accepted, and respected.

Expressions of this theme play upon the individual from birth to death. In fact, the personality and disposition of the woman chosen to receive the child at birth are closely scrutinized; a woman who is lucky with children and liked by them is sought for the task. Not long afterward, when the ears of the child are pierced, the services of a person of similar qualifications are obtained.

Some personality traits qualify individuals for specific tasks and others prevent participation in certain activities. For instance, persons known to be quick-tempered are not permitted to take honey from a beehive; the bees, it seems, sense the irritability of their despoiler and become angry and negativistic too. Wide differences in bravery and in fighting and raiding ability are recognized as well. A story is told of turtles who go on a raid. Though they talk loudly they return empty-handed. Particular individuals are said to be "clumsy like the turtles." Another story tells of a fight between Lipan and Comanche. A Lipan who is coming tardily to the scene of the fight happens upon a captive Comanche woman. He seizes her blanket and, with this as his spoils, returns to his camp instead of continuing on to the battlefield. Although tales of heroism are more common, instances of cowardice are acknowledged. In one episode a Comanche and a Lipan are described as advancing toward each other, shooting arrows. The Lipan becomes frightened and retreats, with disastrous results. According to another story, a brave but foolhardy Lipan engages in argument with a Mexican officer. His companions, who fear trouble and do not wish to become embroiled in the dispute, decide to leave the scene.

Even when a response is of a general rather than an individual character, personal rather than group ends may be involved. If someone calls a Lipan's personal name at a time of emergency, it is difficult for him to refuse assistance no matter what the cost or danger. If someone sings his ceremonial or even his social song without permission, he becomes very angry. If an unrelated person uses his personal property without his consent, trouble is likely to arise.

In matters pertaining to ceremony the personal equation is especially pro-

nounced. An individual may tell others of his experiences with the supernaturals or not, as he sees fit. A woman had an extraordinary experience with a prairie dog about which she said nothing for a long time because she hoped for a vision and a power grant from this source. Only when she was satisfied that the animal was no longer likely to bless her in this manner did she describe her experience. A Lipan woman told me quite frankly that she was not going to discuss her own supernatural power, which was her protection, for fear that it would shorten her life. An old Lipan man gave me a short and obviously incomplete account about a giant spider and then refused to talk about it further, saying that this story was more important to him than any of the others. A Lipan may teach his ceremony to others or refuse to do so as he decides. Often those who are being instructed in ritual complain that their teachers are "holding something back" or "are not giving it all until they are ready to die." Individual ceremonialists take minor liberties with the traditional ceremonial pattern occasionally. Slight variations in the color–directional symbolism are not infrequent, for instance. Individuals may accept or refuse proffered power, and there are interesting tales of both types of reactions and the reasons that impelled them. The attitude of the individual Lipan toward any given power claim or ceremony shows a wide range of variation and reflects all degrees of scepticism, moreover. Belief in the religious round as a totality is universal, but belief in a certain practitioner or claim may be decidedly weak. One story relates how a Lipan rubbed a purported symbol of supernatural power between his legs in contempt. A number of less extreme instances of doubt have also been recorded.

Another concept pertinent to this theme is that an individual should never entirely lose control of his destiny. No matter how generous his inclinations, he should never give all the proceeds of the hunt away. He retains certain parts of the kill without which the envious cannot interfere with his hunting ability. In like manner, he hesitates to teach all his ceremonial lore to another, at least not until he feels that his last days are approaching.

It must be remembered, finally, that an individual does not have to participate in all group enterprises. If he wishes to accompany a war party he signifies this by joining the dance held the night before the expedition is to start. If he does not participate he is not expected to depart with the others. If he has no need for horses he sees no point in joining a raiding party. When an antelope hunt is being planned, a crude charcoal drawing of the animal is carried around to the various camps. Then those who wish to take part gather and organize the venture. A rabbit hunt is arranged in much the same manner. A Lipan engages in most of the fundamental activities of the tribe, for at the level of subsistence at which he lives there are few group enterprises which he can long ignore. But this is usually because of his needs and desires rather than because of a press for conformity.

Theme 9. The Lipan are culturally distinct from and are morally superior to all other groups of people

The Lipan are heirs to a tradition that breeds cultural isolation and ethnocentricity. It is their belief that when the people of the emergence traveled around the earth, though the other strains grew faint-hearted or weary and halted their journey prematurely, they alone fulfilled their mission and reached the place of designation. It is admitted that *individual* Lipan sometimes act in a reprehensible or unworthy manner, but other Indians, white Americans, and Mexicans are said to show by their mass demonstrations of foolish and abandoned conduct that they "follow Coyote's way" as a *group*. Sweeping characterizations of other peoples, which label them "foolish," "braggarts," "dirty," unwilling to "listen to anything good," "mean," "enemies," and the like, come easily to the Lipan and are frequent in my notes.

As a result of this contrasting estimate of themselves as a group and of others, it is natural for the Lipan to believe in their cultural pre-eminence, creative power, and leadership. Even the existence of the Catho-

lic church and the activities of the padre are attributed to the Lipan culture hero! According to the Lipan version, before he left the earth, Enemy Slayer built a church, called a padre to him, and instructed him to pray and to teach the people.

Theme 10. Women are physically and morally weaker than men, are more susceptible to contaminating influences than are men, and are themselves a source of contamination to men

The fundamental attitudes that Lipan culture fosters in regard to women are curiously ambivalent. The evidences of esteem and respect for women will be reviewed later. In this section only the penalties and handicaps under which women labor will be discussed.

Great emphasis is laid upon the greater strength and physical toughness of the male. In explanation of this it is said that the male fetus takes ten "moons" to form within the mother whereas the female fetus requires only nine. Men are expected to swim across rivers; women are pulled across in bullboats. Women are discouraged from accompanying men on the warpath, for their dependence and weakness "make it all the harder." If enemies are sighted in time as they are approaching a Lipan encampment, the women and children are sent to the hills, where they can hide without complicating the task of the men.

Closely related to the greater physical weakness of the woman is her tendency toward excitability. In the stories and accounts, when news of the approach of enemies reaches the encampment, the women are portrayed as rushing about in panic to gather their possessions and break camp. The men, especially the leaders, seek to calm the women and issue orders. That the women occupy an inferior status is suggested also in the tendency of the men to insult each other by reference to the female sex. Nothing angers the Lipan warriors more as they line up to fight their foes of the Plains than to be told in sign language that they are "just like women" or that they should "return home and do women's work." The Lipan fighting men hurl similar jeers at their foes.

The comparative weakness of the woman is considered to extend to the moral sphere, as well. All traditional stories of unfaithfulness and perversion have women as the chief culprits.

Moreover, some of the less pleasant and desirable chores fall to the lot of the women. For instance, the woman sleeps on the side toward the fire; it is her duty to tend it and to rekindle it in the morning. In addition, there are a number of minor but interesting disqualifications levied against women. A woman may not play the musical bow. She may not approach the level place where the men play the hoop-and-pole game. She may not wear clothes made of skins smoked during the tanning process. She allows the men to keep track of time for all formal occasions.

As so often is the case, special cautions apply to women during pregnancy or at the time of menstruation. A pregnant woman is prohibited from watching the masked dancers perform. A menstruating woman must refrain from touching a man's hair lest she cause it to fall out. In fact she avoids contact with men as much as possible during the period, for men may become rheumatic as a result of touching or even of smelling menstrual blood. Menstruating women are expected to stay away from curing rites, for their presence only makes the condition of the patient worse.

Women are alleged to suffer from some particular sensitivities to sickness or evil influence. It is a hazard for anyone to handle feathers of the eagle, crow, or raven, but the danger is more pronounced for the women. Women avoid passing through an ant hill; a woman stung by an ant is likely to develop a high fever.

The two points at which women are restricted in ceremonialism have to do with the sweatbath and the rites centering around the use of peyote. Women are barred from the sweatbath, which, indeed, is often used by men who have been made ill by contact with menstrual blood. At one time women were never permitted to come near the place where a peyote ceremony was in progress. Later, when peyote became more commonly used for curing purposes, the rule was relaxed and women were brought into the tipi for short periods to be healed. The

justifications for barring women are that peyote makes men particularly sensitive to odors, and that men who have eaten peyote vomit (a harbinger of evil) if they detect the body odor of a woman. In fact, the incompatibility between peyote and women is so great that a man who is eager to learn the lore of peyote is urged to "go out by himself and to stay away from women." For the same reason the tipi in which a peyote meeting is to be held is never erected near a camp where women are likely to be living.

Theme 11. Women play an important part in the social, economic, and religious life of the tribe

In spite of the disabilities and restrictions to which women are subject, they play an important and recognized role in Lipan culture. It may very well be that some of the emphasis upon feminine weakness that has been noted functions to keep the woman bound to the home, dutifully domestic, and at least partially dependent upon a body of male relatives. Yet it is well understood that the woman contributes generously to all phases of Lipan life. The gathering of the wild food plants with which she is occupied provides as much for the larder as does the hunting in which the man is engaged. Residence after marriage is matrilocal; it is the woman who acts as the stable nucleus of the new family unit. Sons depart from the paternal encampment at marriage. It is the girls who bring strong young men, the sons-in-law, to aid their father with his tasks. Consequently, the birth of girls is welcomed in a family and there is no inclination toward female infanticide.

If women suffer certain disadvantages, they enjoy many equalities and even have prerogatives, too. With the exceptions already discussed, women obtain supernatural power and perform ceremonies on a par with men. Because only women may make clay bowls for pipes, those that the men use in ceremonies must be obtained by them from women. The ceremony performed over a new tipi is entirely in the hands of women; it is an old woman who selects, blesses, and marks the poles and who sanctifies the beds and the firepit. At a birth all men and boys must stay away from the place of confinement; otherwise the woman in labor will have much trouble.

One of the most important Lipan rites is held over the pubescent girl. Much food is stored away well in advance for the event, and the ceremony is an occasion of general rejoicing on the part of the community that a girl has been reared to maturity. The maiden who is the central figure of the rite is called "Changing Woman" during this period and is considered to have power for things beneficial. Small children are brought to have their bodies pressed by her so that they may grow strong and straight.

The women, too, have their own game of chance, the stave game. Men are not forbidden to play or to watch it, but since it is considered rather effeminate for a man to take too active an interest in it, the women have this type of recreation pretty much to themselves.

Though women take no active part in the deer hunt, they contribute to the good fortune of the hunter by performing certain acts at home. A woman whose husband is hunting prays for his good luck and safe return and, in anticipation of the hides he will bring, lays out the implements with which she tans buckskins. Women actually participate in the antelope hunt, and the men practice something akin to chivalry at this time. A man is not permitted to overtake a woman who is pursuing an antelope or to kill the animal for himself. If a woman hits an antelope with her rope, the man nearest the scene must dispatch it for her. The men are also obliged to kill an antelope that a woman ropes. Furthermore, men are expected to give meat to women who arrive from the rear empty-handed just after the antelope hunt.

While warfare is primarily man's concern, Lipan women are not entirely passive in relation to it. At the war and scalp dances women only are permitted to utter a formalized call signifying applause. At the time of the war dance old women whose relatives have indicated their intention to join the war party may throw their husbands' quivers on their backs and dance among the men. On the return of the war party, prisoners are turned over to women who have lost family members in the fight, to be

stabbed by them in the throat with lances and knives.

The Lipan woman is relatively secure in her marital and social position. The home, the household equipment, and her personal effects belong to her and are inviolate. She eats with her husband and is treated by him on a plane of equality. If a separation takes place and the man has left his possessions behind, the angry wife can simply throw his belongings out of the door. In case of divorce, children remain with the mother. A woman who learns that her husband is unfaithful can let him know of her discovery by killing his favorite horse. She is viewed sympathetically if she goes as far as to attack her rival physically. A woman is well protected from a husband's abuse or imposition by virtue of her residence among her own relatives. If the husband proves to be an indifferent son-in-law and a poor provider, his wife's relatives are likely to drive him away or to "take away the girl." If a man is mistreating his wife, her father and unmarried brothers can be expected to intervene and send the quick-tempered husband away. At the same time, they have no desire to lose the services of an industrious son-in-law and brother-in-law, and therefore they can be expected to defend the man and discipline the wife when the fault is clearly hers.

Theme 12. Children are particularly susceptible to natural and supernatural dangers and must be aided and protected by various rites and practices

It is not astonishing that the Lipan, with their heavy sense of danger and lurking evil, are particularly concerned for the safety and well-being of their children, the group among them that seems most helpless and vulnerable. In the Lipan view, the hazards of the early period of life are so great that if a child is to grow up to be healthy and free from serious defects, constant protective rites must be performed and many precautions must continually be taken.

At birth the first soft hair is cut from the head with an obsidian blade. If this is not done the child's forehead will remain small. A few days after birth the ears are pierced so that the child will have good fortune, will listen to what it is told, and will obey the parents and keep out of mischief. The mother and grandmother carry out a little rite, using pollen and the ritual feint, when the child is first placed in the rawhide carrier. A baby is not fed anything from the head of an animal before he is weaned; otherwise he will be tongue-tied.

When the child is ready to walk and eat solid food, the first moccasins ceremony, held to insure long life and good health for the child, is performed. In the spring when the child is about two years old, there is a hair-cutting ceremony in which he is blessed and identified with growing things.

At all times great care is taken in disposing of the baby's feces. If they are carelessly left on a path where someone steps in them and scatters them, the child will suffer from a digestive ailment. It is a common practice, when the moon is one day old, to lift a child to it four times and pray that he will grow tall and strong, be active, and remain in good health. A general protective ceremony to enable him to grow up safely and to have good fortune throughout life may be performed for a child at any time by a shaman. Often, too, in order that a child may grow strong and straight he is brought before the pubescent girl to have his body pressed and molded by her. Parents who want their child to have a particularly lucky name communicate their desire to one who is known to have great supernatural power. If this person can not think of an appropriate name at once, he waits until one is suggested to him in a dream and then formally bestows it on the child.

Children are sedulously guarded from certain evil influences to which they are said to be extremely sensitive. Death and all that it involves are most baneful to them; therefore children are shielded from the sight of a corpse or a grave and are insulated from any mention of death. Scalps are kept far from camp so that children who are playing will not encounter them. The eagle, red-tailed hawk, and owl are believed to give serious diseases to children and are not brought into a home frequented by young people. Crow and raven feathers are said to cause swelling of the joints, and children

are instructed never to touch them. Children are advised to chew and swallow the first four hailstones they find when a storm strikes; then they will be less afraid of thunder and lightning and less likely to be harmed by them.

All kinds of amulets are attached to the clothing of children or are brought into contact with them to guarantee specific abilities, protection, or simply "good luck." The yellow tip of cholla or a piece of rock crystal is tied to clothing for good fortune. The skin of the red tree squirrel is attached at the back so that the child will learn to climb trees and rocks readily. Seeds of the wild gourd are strung and worn as a wristlet to immunize against epidemic. The tail of a cottontail rabbit is fastened to the moccasin of a youngster to make him swift of foot. The right paw of a badger sewed to the back of his shirt will help a child develop strength for wrestling and lifting. So that he will be able to carry heavy loads in the future, a child is gently struck on the back with a beaver tail.

It is felt necessary to protect the future and prospects of the young to the very threshhold of maturity. As a supplication for long life the first cigarette smoked by a youth must be rolled and blessed by an old person. The youth who is ready to venture upon his first raid or war expedition is taken by his parents to an elderly person. He is blessed by this person and receives instructions from him concerning his obligations and the proper behavior during this period.

Theme 13. Childhood is a period of preparation for adulthood rather than an important phase of life in itself

As we have seen, childhood is thought of as a period when dangers have to be offset and combated so that the young may reach maturity. In keeping with this emphasis upon survival to maturity rather than upon childhood's pleasures, there is a logical stress upon learning the tasks appropriate to adulthood. Childhood is a condition to leave gratefully and as quickly as possible; it is only a training ground for the period of existence during which the individual finds greater security and the opportunity for self-realization.

The whole temper of instruction in childhood can be judged from the constant advice to act in ways that will confer future benefits. Youngsters are told to chase rock wrens if they wish to be limber and to run after butterflies if they hope to become long-winded. From earliest years the child hears stories having a didactic purpose: the boy listens to the tale of the worthless turtles who return from the raid without plunder; the girl is told about the "foolish woman" who knows so little about the care of infants that she inadvertently kills her own baby. It is not long before the little girls are holding a puberty rite in play and are anticipating the role they will one day be called upon to fill.

Play is cleverly directed into channels that lead toward the tribal economy. Parents encourage children to play "bucking horses" with the small children astride the older, telling them that the game will help them to capture and tame wild horses one day. Children play a game in which a stick is thrown through a hoop called the "deer" or "buffalo." They also play realistically at buffalo-hunting or horse-raiding, relying upon the accounts of their elders for the details.

As soon as possible the adults see to it that a transition is made from play to reality. Boys are directed to tend and water the horses; girls are sent for water and wood. As soon as they are strong enough to handle the equipment, children are taught to use the firedrill. At a relatively tender age boys build bird blinds and perfect their aim from its cover.

The children respond to the cult of bravery and the demonstrations of bravery to which they are exposed and test each other with gusto. To prove their fearlessness and fortitude they allow a burning brand to be applied to their fingernails, they lie down and allow one of their number to stand on their calves, they burn pith to ash on their outstretched arms, and they catch snapping turtles in the water.

The final stages of training are arranged for the young people by the adults. They are forced to plunge into icy water and are then ordered to build their own fire in the

open with a firedrill. For the boys, mock battles are organized in which the sides use shields, bows, and blunt arrows, slings, and lances of sunflower stalks. The relation between learning to dodge with precision and future survival is made painfully clear to the growing boys at this time.

After puberty the girl is made to feel that the fulfillment of her destiny depends upon the mastering of all woman's crafts and tasks and the founding of a home of her own. Into the boy is instilled the manly conception of acquiring booty and horses of his own. Thus, both the boy and the girl are normally eager to assume adult status and obligations as early as the ranks of their elders will open to receive them.

Theme 14. The extended domestic family is the basic social and economic unit and the one to which first allegiance and duties of revenge are due

The extended family as it is defined and understood by the Lipan consists ideally of a man and woman, their unmarried daughters and sons, their married daughters, and their sons-in-law. Therefore the women of the family camp-cluster or extended family are all blood kin, whereas some of the men are blood kin and some are united to the family through marriage. These affinal relatives are not indifferent to the family they left when they wed, but, as we shall presently see, Lipan society binds them to the family they join at marriage by obligations and sanctions extraordinarily demanding and uncompromising. Consequently, a Lipan is expected to resent an insult to the relatives by marriage with whom he lives as much as do the other members of the family. It is an affront to mention the name of the recently deceased before his blood relatives; it is more provocative still to do so in the hearing of his affinal relatives. In short, everything that is expected of a blood relative is required also of a relative by marriage, and a solidarity and common interest among its members are achieved that make of the extended family the basic productive and social unit of Lipan society.

The family, as it is defined above, is an autonomous and, as far as the band or tribe is concerned, a mobile unit. Its members may decide to stay behind the main body, to push ahead of the others, or to undertake some venture of their own. That they normally stay with or near a larger body of tribesmen is due to the greater security, livelier social life, and more frequent economic advantages that come from this course, and not because of orders from above.

In addition, the family is the most prominent functioning economic unit; together its members plan work and the utilization of the products acquired. Whether the women cook together or separately, no branch of the family goes hungry while another branch has food. The feeling of responsibility for family members is always close to the surface. In the myths and tales a common assertion of the father in respect to his food-getting activities is, "With this I feed my children."

The consciousness of family solidarity and responsibility fans out into all aspects of the culture. The child is considered to be reared by the family as a collectivity. In advising a grandchild, a grandparent often reminds him, "*We've* had a hard time to raise you." Marriage is obviously an agreement between families. When a boy hints that he is interested in a certain girl he is likely to be told, "We will try to get that girl for you." And the effort is a joint one, for the members of the group discuss strategy and together assemble the objects constituting the marriage gift. At the time the question is put to the girl's parents, they consult with the members of the extended family before announcing a decision. If the answer is in the affirmative, these relatives of the girl, as a reward for their contribution to her education and growth, are allowed to divide the wedding presents among themselves. The interfamily understanding established at a marriage is one that should be honored as long as possible. If a married man dies, his unmarried brother should properly assume his place and his duties. When a married woman dies, her unmarried sister is expected to take her place.

The quest for supernatural power is not untouched by this theme. Power is often

described as "something with which to watch over my children and my family."

At a time of trouble, members of the family of the person in difficulty have first responsibility and they take care of the situation alone if they can. For example, a woman's horse ran away with her during an antelope hunt. Her relatives had to turn around and chase the unruly mount; the others went on to secure the game.

The central place of the family is also evident in the practices of raid and warfare. If a family member is captured or killed the men of his group immediately set out to rescue him or to obtain revenge. If they are living in a large encampment they appeal to the chief to organize a large, strong party. The mission is publicly announced, and all those who wish to show their sympathy or indignation can join the venture. In an expedition of retaliation members of the injured family exert considerable influence even if they are not of chiefly rank. A narrative is told of a battle between Lipan and Comanche in which the Lipan finally gained the upper hand and seemed about to exterminate the enemy. The slaughter continued until the father of the man over whose death the battle had started motioned to allow the few remaining Comanche to flee. As a final gesture of his victory and revenge he wished the few survivors to straggle back to the Comanche camps to tell the story of their defeat.

A warpath episode neatly reflects the Lipan attitude toward the obligations of family members. A small group of Lipan, among them a prominent chief, were pursued by a large force of the enemy. The chief was wounded and could ride no farther. A decision had to be made concerning who would remain with the wounded man and attempt to fight off the enemy until aid arrived and who would ride to safety and notify the camps. The answer was obvious to the chief, for some of his followers were family members and some were not. To the latter he said, "You are not related to me. Go back. These others are related to me."

It has already been mentioned that male prisoners are turned over to the women of families who have lost members in battle for execution, and that a woman whose relative has pledged himself to go to war by joining the war dance may dance on this occasion also. If the Lipan have lost a warrior, the next time an enemy scalp is taken, a ceremony is performed over it so that the mourning relatives "will not be so sad."

Since so much in the way of activity, restraint, decision, and authority stems from the family, it is inevitable that most of the tensions and anxieties should involve this group of kin as well. Nowhere is this more apparent than in regard to witchcraft fears and in the reaction to death. All Lipan recoil from the thought of death or of ghosts or from contact with a corpse. To the family members of the deceased, however, the presence of death is particularly contaminating and harrowing.

Theme 15. Relatives of different degree have particular roles to perform in respect to the individual; depending on the relationship involved they are expected to act either as protectors, friendly rivals and critics, or as teachers and disciplinarians

The essence of the obligation of the Lipan parent toward the child can be summed up in the word "protection." This protective attitude begins even before the birth of the child; it is the Lipan dictum that "a woman must be careful when carrying a child; a child is like an egg." Husband and wife discontinue sexual intercourse as soon as they discover that the woman is pregnant; to do otherwise would result in the child's death, they believe. To prevent harm to the fetus, the pregnant woman refrains from eating certain foods; she believes that if she eats of a fetal animal the child will be born with impaired eyesight, that if she eats liver or intestines, the umbilical cord will be wound around the child, that if she partakes of the stomach of an animal the child will have a film over his eyes, and that if she eats the kernels of hard-shelled nuts the child will be handicapped by a small, upturned nose. After the child is safely born the parents still must postpone sexual intercourse until he has been weaned, for if the mother should become pregnant while the child is nursing he will suffer from a serious

stomach disorder. Some of the amulets and ceremonies by means of which the parents seek to shield the child from danger and malice have already been described. It is the parents who lecture the child about wandering too far from camp and who attempt to instill in him a sense of the surrounding dangers. If the children play games considered too dangerous the parents are ordinarily the ones to intervene.

Since the Lipan parent is cast so completely in the role of provider and protector, the society reacts harshly against the mother or father who shirks these duties. A significant Lipan story tells of a woman who abandons her children to marry a man from whom she conceals that she is a mother. The children undergo severe hardship but survive and prosper. Years later they find their mother in reduced circumstances. The girl refuses to give her mother food; the son slays the erring woman.

At the time of the girl's puberty rite, visitors come from a wide area to congratulate the parents on having brought their daughter to maturity; it is recognized that an important goal in the lives of the hosts has been fulfilled. It will not do to oversimplify the position of the parents, however, for they have many other functions in respect to the child besides the one mentioned here. They have a share in the child's education and instruction, the bond between parent and child is often warm and affectionate, and so on. But Lipan culture is particularly sensitive to danger and alert to those inimical forces that seek to strike at the young. It is not surprising, therefore, that the parents have been made to feel primary responsibility for the safety and well-being of their children.

In Lipan society the grandparents, particularly the maternal grandparents, take much responsibility for the care and instruction of the young. The convenience of such an arrangement is apparent. The father and mother are often away on economic errands. Older people, such as the grandparents, are more likely to stay behind and can therefore attend to the camp chores and supervise the children. When a mother dies, the maternal grandparents usually open their home to the children. If the father does not stay in his deceased wife's encampment to reestablish the family unit, the children usually remain with the grandparents permanently. Since, with matrilocal residence, a daughter remains near her parents throughout life, it is convenient for her to seek their advice and cooperation in connection with problems regarding the rearing of her children. The grandmother assists the mother in the little ceremony performed at the time the child is placed in the rawhide carrier. It is the grandmother who brings her grandchild to a pubescent girl to be blessed. At the time of the girl's puberty rite, her grandmother gives her pertinent advice and helps her mother prepare her. The grandparents often conspire with the parents to discipline the child. The parents, for instance, tell a disobedient child that he is going to be thrown to the coyotes if he does not behave. The grandparents help with the pretense by imitating the cry of the coyote from a distance.

But the grandparents do much more than simply assist the parents with problems of child care on occasion. They accept primary responsibility for the instruction of the young. The grandparents are the ones who tell the traditional stories, many of which are of a didactic nature, to the young people. The grandfather normally teaches the boy to shoot arrows and performs the ceremony over his first kill; the grandmother guides the girl in the acquisition of many household skills.

Lipan society has empowered the grandparent to deal as roughly and directly with the child as is thought necessary for his proper education and training. In the eyes of the Lipan child the figure of authority and strict discipline is not the parent but the grandparent. And, interestingly enough, the psychic phenomena that are usually induced by resentment and repressed antagonism are most often attached, when they appear, to the grandparental image. The terrifying hoot of the owl is likely to be interpreted as the voice of the deceased grandparent; in stories of the underworld more often than not it is the grandparent who wishes to retain the visitor in the land of the dead. The Lipan grandparent is free with threats if he thinks they will quiet his

charge or chill him into better behavior. He threatens to give the child to the Lipan boogy-man (the call of the poorwill is his voice), to throw the child to the fishes, to castrate him, or to cut his throat.

The tenderness of the grandparent toward the grandchild is masked by a rather rough and coarse "joking relationship." In terms of one aspect of this "teasing" it is the grandparent's privilege to play practical jokes on the grandchild, to duck his head in water, poke his horse when he is mounted, and the like. The grandchild retaliates as he can. The other face of this "joking relationship" is the right of grandparent and grandchild to banter with each other about marriage and sex. A grandmother will remind her grandson that she intends to marry him when he grows up and that she will be jealous of any woman who attempts to interfere. She sharpens a knife ominously to indicate what is in store for any rival. The grandfather will declare that any man who takes his "wife" away from him will have to give him a horse to prevent trouble. After the grandchildren are married, the grandparents engage, but only when the grandchildren are present, in mock bickering with their mates.

This socially sanctioned custom of great freedom in the discussion of intimate matters makes of the grandparent a logical person to instruct the grandchild in sex, and the conveying of such information is one of the recognized functions of the Lipan grandparent.

Another special Lipan relationship involves the mother's brother and his nephews and nieces (his sister's children). In the case of the niece and uncle, the relationship rarely goes beyond teasing and bantering; in the case of uncle and nephew, however, it is marked by pranks, contests, and active rivalry, as well. Uncle and nephew pour water on each other, hide each other's moccasins, and one of them may attempt to startle the horse upon which the other is riding. If one of them is on horseback and the other is on foot, the rider may run down the pedestrian, acting as if he intends to strike him with the whip. Or to show how lazy and worthless he deems him to be, a Lipan will remove the saddle from this relative's horse and arrange the saddle blanket over it to resemble a bed. More important, the uncle and nephew compete to see who can accomplish the bravest feats in riding, raiding, and fighting. In this way they set standards for one another, and each stands ready to ridicule the other in the event of poor performance or failure. It is plain that this is one of the devices by which the culture keeps martial spirit and manly competition at a high pitch.

Lipan siblings (brothers or sisters) and cousins of the same sex are friends and comrades. But they, too, have a formalized joking relationship, one in which they tease each other about mates. One woman, for example, put on a man's hat, made her way at night to her cousin's bed, imitated the voice of a man who stayed in the home but who was absent at the time, and stroked her relative's breasts and thigh. When the victim became indignant the hoax was revealed. The man who had been imitated was married to a cousin of the two young ladies involved and so, in joking parlance, was a "husband" to them. This willingness to joke about so delicate a subject is considered proof of brotherly, sisterly, or cousinly amity and indicates that "all can get along together."

The relations between siblings or cousins of opposite sex, however, are marked by the greatest restraint. When a child is old enough to take admonitions seriously, he is warned to utter no "dirty word" before his sister and never to relieve himself in her presence. Warnings and restrictions are added, until, by the time of puberty a boy will not use the dish from which his sister eats, he will not touch her clothes, he will not sit where she has been resting, and he will not enter a dwelling in which she is alone. The very lice of a sister are extremely poisonous for the boy. A bite from one of these lice causes skin erruption which can be cured only if the relative from which it came chews the afflicted spot. The attitudes and behavior patterns that mark the conduct of brother and sister toward each other are observed by cousins of opposite sex also. In fact, restraint between cousins may be even more inflexible, for, if one of the principals (usually the woman) decides to show

the ultimate in respect toward the other, total avoidance is substituted for mere reticence. This, incidentally, is the only instance in which Lipan society sanctions a relationship of total avoidance.

Theme 16. The obligations of the married man and woman to their relatives-in-law are extremely comprehensive and solemn

In order to guarantee the smooth functioning and the productive capacity of the extended domestic family, the fate and interests of the young men who join the unit at marriage are strongly linked with those of his relatives-in-law. This is accomplished by making the in-law obligation of service and obedience, and particularly the son-in-law obligation, one of the fundamental tenets of the culture.

When a Lipan is about to marry, his father tells him, "Now you're going to marry that girl. Do what her relatives tell you no matter how hard it is. Put your camp on the dangerous side. Be the first to shoot at the enemy. That's the way married life is." It is the son-in-law's primary duty to provide for his wife's parents. The very marriage gifts are a token of this; they represent the willingness of the young man to help his wife's relatives with his possessions. It is cause for most unfavorable gossip if a man is stingy toward his in-laws and refuses to give them anything within reason for which they ask.

The less desirable and more precarious tasks of the encampment are likely to fall to the lot of the son-in-law, especially during the first years of marriage. He may be asked to break dangerous horses, to ride out to identify persons unknown who are approaching the camp site, to get horses that are grazing at a distance, or to care for visitors' horses. If a man performs his duties indifferently or if he treats his wife badly, his relatives-in-law may send or drive him away. If he fails even more completely, worse may befall him. A story is told of a man who flees the camp during an enemy attack in which his wife and child are slain. When he returns his life is threatened by stern relatives-in-law who upbraid him for deserting his post and neglecting his wife and child. A female cousin of the slain wife intercedes for him and saves him, but he has to pay the family and this woman much property before he is allowed to go elsewhere and remarry.

Once a son-in-law proves his worth, however, his wife's family looks on him with favor and will help and defend him. If the wife threatens to divorce a good provider, her family will bring pressure upon her to live with him again. When the woman is plainly at fault in some domestic dispute, her kin often side with the husband. There is a tale of an unfaithful wife who feigned death to disappear and go to her lover. When her deception was discovered, her family gave the husband a free hand in dealing with her. Though he slew her, they required no mourning of him and offered him another daughter in her stead. The Lipan family is slow to reject a relative-in-law who is considerate and useful. A Lipan whose wife wished to divorce him and marry another gave the woman pause when he shrewdly asked, "Do you think he will be as good to your parents as I have been?"

Although the main burdens of the relative-in-law obligation fall upon the married man, the Lipan conception of marriage as a compact between two families implies that the woman is not without duties toward her husband's kin, as well. In fact, a woman's kin, when she is about to marry, tell her to be a good wife and to obey her relatives-in-law. Actually the demands of her relatives-in-law upon her are very moderate. Once in a while, to remind her of her duties and of their existence, they ask her to do something for them.

It is at the time of death that the supervision of the relatives-in-law over the individual becomes most sweeping and onerous. The widower is obliged to remain with his dead wife's relatives. He obeys all the rules of mourning; he cuts off some of his hair and leaves the rest uncombed; he dresses poorly; he shuns social events. He continues, nevertheless, to hunt and provide for his parents-in-law. After approximately a year, this family, if they wish to retain his services, offer him a sister or cousin of his dead wife in marriage. He is obliged to accept. If they have no fault to find with him during the

mourning period but have no girl to offer him, they must set him free. The severing of the ties is accompanied by formal expressions of regret and by the presentation of gifts to the family by the young man. If it is the man who is eager to gain his freedom, after a reasonable term of mourning, he offers "to buy his way out" and, with the help of his own family, amasses the amount of property upon which there has been agreement.

At the death of her husband, the widow, too, falls under the control of her relatives-in-law. She remains in her own encampment, but she is required to mourn in the traditional manner and must accept as husband the brother or male cousin of her deceased husband if her relatives-in-law so decree. If she wishes to make marital arrangements of her own, she must first gain the consent of the family to which she is bound.

If a widower or a widow takes the mourning requirements too lightly, attends social functions too soon after the death or remarries without permission, the relatives-in-law become greatly incensed and, with public sympathy solidly behind them, seek vengeance. A woman of the aggrieved family may bite off the tip of the nose or the ear of the offending widow. A man who remarries without permission may have his horse confiscated or may be stabbed at the first opportunity. The woman who dares marry him, though he is still committed to another family, may be attacked. Because of this danger, the family of the new wife, in an attempt to compound the matter, sometimes offers presents to the outraged relatives. It is important that some understanding be reached, for "the families never forget it." A typical case is that of a man who remarried without the permission of his dead wife's family. Years later, at a social gathering, a woman of the outraged family turned on him, reminded him of his offense, and stabbed him. He wrested the knife from her and killed her on the spot. A general fight ensued in which two of his relatives who came to his rescue were killed. Clearly the Lipan show by the vigor with which they enforce them how important they hold the son-in-law–daughter-in-law obligations to be.

Theme 17. Industry, generosity, and bravery are the cardinal moral–social virtues

There are a good many character traits and personal attributes that the Lipan rate highly. Truthfulness, wisdom, attention to etiquette, cheerfulness, piety, and modesty in women evoke commendation. But there are three moral–social virtues that are set aside from all others for special emphasis and notice. These are industry, generosity (kindness), and bravery.

The sun is the symbol of the need for industry. When human beings were first created, Sun ordered them to arise early in emulation of him. The old people constantly remind the children of the importance of doing something useful at as early an age as possible. To impress this upon them, even in jesting, one old man repeatedly described to his grand-children how he used to get up before dawn to suckle at his mother's breast, go out to hunt, and return to suckle again.

Those who guide the young never lose sight of the cardinal virtue of industry. At the birth of a male infant, the midwife holds him up and prays, "May he grow up to be well, to live long, and to become a good hunter and warrior." She prays that the girl child may be a "good worker." At the first moccasins ceremony a little boy is given a small bow and arrows so that he may excel in hunting; the girl receives an awl so that she will be proficient at sewing. The elders take care to channel children's play in the direction of adult work patterns. The mother seeks to interest the girl in "playing camp" and carrying wood, for example. As soon as a girl is considered old enough to handle fire safely, she is taught to cook. Boys and girls are urged to hunt pack rats, which are utilized as food. The girls poke the brush to force out the rodents; the boys shoot them with arrows as they run.

The Lipan conception of industry involves accomplishment as well as activity. The children are always reminded of the "foolish people" who brought back only rawhide from the raid and of the turtles who

talked a great deal about the rigors they had undergone but who secured nothing on the raid. The young Lipan who has a reputation for sloth has a difficult time indeed. Even though men are attracted to her, their relatives will oppose union with a lazy girl. A boy of doubtful work habits is likely to receive a negative answer from the family of the girl he wishes to marry. Even if he is accepted his lot will be hard, for he faces the displeasure and petty persecutions of relatives-in-law who feel that he is providing inadequately for them.

Generosity is another attribute that Lipan culture encourages and holds in great esteem. Any younger person who hesitates to contribute his full share of goods or services when he is called upon for help is told, "You'll get it again as you go along. When you are old you'll be helped too." If neighbors need assistance, parents and grandparents urge their children to volunteer aid; when sickness or trouble strikes nearby, girls are told to go to the disrupted household to carry water and wood, and boys are sent to care for the horses. It is a Lipan rule that a friendly visitor has to be fed, even if a horse must be killed to supply the meat. If the visitor's horse is tired and he must go on, he is given a substitute mount. If he has no horse and has a long and arduous journey ahead, he is presented with one. If his moccasins are worn out, he is supplied with new ones.

Men who return from raid or war with spoils keep relatively little for themselves; at the victory dance they distribute most of what they have seized from the enemy, often to the poor and needy. Hunting customs are marked by canons of generosity too. When two men are hunting together, it is not the man who brings down the game but his companion who is entitled to the hide and as much of the meat as he wants. A successful hunter, if he is asked for food when he is going through the camps, is expected to honor the request without hesitation. Of course, those who take meat from the hunter usually exercise moderation and are guided by their actual needs, for they know that they are subject to similar demands when the situation is reversed. But the successful hunter ordinarily does not in the least resent these requests and is likely to distribute meat to surrounding camps as a neighborly gesture in any case.

It is not difficult to establish that bravery is one of the outstanding virtues recognized by the Lipan. We have already seen that Enemy Slayer, the culture hero, is essentially a warrior and raider and is credited with establishing what is, in effect, a cult of bravery. The tests of fortitude and courage to which the growing child is subject and the Spartan rigors of the child training and hardening process have already been described. Lipan story-telling sessions are usually enlivened by accounts of the heroic deeds of Lipan fighters. To be called a coward, a "crow," or a "woman" or to be charged with avoiding danger because "you always want to live a little longer" is a provocation beyond endurance. As an example of how true Lipan act, the anecdote is told approvingly of a small group of Lipan whose horses were stolen by a much larger force of the enemy. Because of their superior numbers the enemy felt perfectly secure and moved eastward at a leisurely pace. But the Lipan said among themselves, "These people think we are cowards. Let's show them. Let's follow them and fight. Let's die bravely!"

Participation in the war dance is a pledge to be brave and join the expedition. Feather headdresses and headdresses ornamented with buffalo horns can be worn only by those with significant war deeds to their credit. One of the bravest acts possible is to enter a fight armed only with spear and shield, for a warrior without bow and arrows must engage his foe at close quarters. To be the first to touch a fallen enemy is considered an extremely heroic feat, too, for the companions of a downed foe usually rush forward to save him and to prevent his scalp from being taken; therefore hand-to-hand combat is precipitated. At the victory or scalp dance a warrior is permitted to describe his deeds and to call upon others to verify his statements. He also has the privilege of conferring upon children names associated with his war deeds.

The Lipan explain that bravery and com-

mendable exploits in war result from training, self-control, and decisiveness. These qualities are operative during peace as well as in time of battle. Therefore, those who can accept adversity in peacetime stoically or who show these admirable qualities in mastering a difficult domestic situation are said to have "a brave heart" also. Such a man was the one who, upon discovering that his wife was carrying on an affair with a rival, took his bow and arrows, went to the man's dwelling, and questioned him closely as to whether he cared for the woman and whether he would marry her if she were free. The man answered in the affirmative throughout. The husband then divorced the woman and bade the two marry. Had the rival indicated at any point that he was not infatuated over the woman but was merely enjoying himself at the expense of the husband's reputation and prestige, the husband was prepared to kill him on the spot. By demonstrating that he controlled the situation and that he made the final decision, the husband, even though the episode ended without bloodshed, proved that he possessed "a great heart."

Theme 18. A leader is a man who is more zealous than most in the discharge of the principal social–moral virtues and who is willing to assume the responsibility of office

All discussions, explanations, and stories bearing on the subject of leadership establish that the Lipan leader or "chief" is the man who most conspicuously exemplifies the three prominent social–moral virtues. A man destined to be chief may display greater than ordinary seriousness and industry. He establishes a reputation for earnestness and for being a good provider. Then he shows courage and daring in raid and war. As a result of his industry and bravery he brings home meat and enemy possessions. But he sympathizes with the widow and the orphan and gives almost all his property away. Always he gives judiciously and wisely to those who deserve aid. His industry, bravery, and generosity do not go unnoticed but are increasingly the topic of approving comments. He is now so well considered that people defer to him and constantly ask his advice. He has many visitors whom his wife always feeds well. Sooner or later some emergency arises and he is appealed to or asked to make a decision. If he takes command and gives directions and the crisis is resolved successfully, his leadership is thereafter assumed.

The chief does not dress elaborately; in fact his clothes may not be so fine as those of other men. A story is told to illustrate this. Two Chiricahua Apache who were captured asked to be allowed to speak to the chief. The chief was pointed out to them but they ignored him and insisted on addressing a man who was better clad. This finally angered the leader and he ordered them put to death. The only insignia of rank the leader wears are a downy eagle feather and an abalone shell attached to the scalp-lock. The shell, a symbol for the north star, suggests the steadfastness of the leader.

In times of crisis or emergency the chief issues orders on his own initiative. When time will allow a discussion of any problem that troubles the group, however, a council of family heads is held. At this council the chief's views ordinarily count heavily, but it is the consensus that carries the day. For the most part, then, the chief is the spokesman for the people rather than a strong source of authority. He announces the dates of movements and expeditions. He delivers the homilies on preparedness and good conduct which everyone expects and no one, seemingly, ever tires of hearing. The chiefly qualities are a magnification of the ordinary virtues which the Lipan extol, and the chief's voice is the medium for expressing those things that most of his followers accept or wish to see undertaken.

Theme 19. Long life (old age) is an important goal for the individual to reach

We have already noted the Lipan's frank recognition of the evils—sorcery, disease, enemies—that continually threaten the individual as he travels the path of life. So acute are the dangers felt to be that existence itself is interpreted as a challenge to the death forces, with a long, full, and satisfying life as the brave goal. In keeping with

this mood, Lipan ceremonialism is largely an elaborate device to preserve or protect life, and most of the ceremonies are curing rites or rites performed to prevent anticipated sickness and disaster. There is scarcely a religious song or prayer that does not include a reference, direct or oblique, to the desired longevity.

Because young people are believed to be tender and susceptible and to lack protective power of their own, many of the rites of childhood contain prayers or practices designed to guard them during this critical period and to help them live to an old age. A prayer that the child may live long is uttered at the very time of birth. A general protective rite lasting two or four nights is often performed over an infant to increase his life expectancy. If a child's kin have been moving from one locality to another, when they return to the place where the baby was born, he is made to roll on the ground, an act thought to help ensure a long life. In the first moccasins ceremony, the four steps to the east the boy takes as he leans upon the bow and the four steps the girl takes as she supports herself with the "age stick" are considered a prayer for long life and an instrumentality for reaching great age. At a girl's puberty rite, an abalone shell is pressed to her body; if it adheres to her, this is considered a harbinger of the long life she will enjoy. In the ceremony conducted when a new tipi is erected, the fire poker is referred to as the "age stick" and is considered a symbol of the long life desired for the occupants.

In the belief that persons who have lived many years can transfer this ability to those starting out in life, the aged are often associated with the young on special occasions. Thus, old people are sought to act as shamans for the first moccasins ceremony, for the spring hair-cutting ceremony, for the ceremony held at the erection of the new tipi, and for the ceremony of purification following a death. An old person is asked to roll the first cigarette for a youth and to give instruction to a boy who wishes to join his first raiding party. A name conferred on a child by an old person is considered particularly lucky. An old woman is the first person to mark the face of the pubescent girl with pollen, and she often brings her grandchild with her and helps him perform the same act. In dealing with the young, the wisdom attributed to the old is emphasized. The grandmother tells a girl, "You will live to be old like me if you listen to my advice."

Because of their greater "toughness" before evil onslaughts, gained during the years, old people, it is thought, can prepare and bury a corpse with reasonable immunity.

Those who die while they are still young or active are removed from life when their aims are unfulfilled, when they are struggling for recognition, affection, position, and favor. Therefore, they may die dissatisfied and vengeful, and their ghosts are greatly feared. But the person who dies, not from sickness or by violence, but simply because his body wears out, is beyond earthly cares and desires and dies serene and without rancor. There is no fear of his ghost; the usual mourning observances are waived. In fact, as his death approaches, his relatives gather around him for a last blessing and to pray that they will live to be as old as the one who is going from them.

Theme 20. Death, except of the very old or the very young, is extremely contaminating to the survivors, and the corpse, the grave, and the ghost inspire intense fear

Death not only brings economic dislocation and personal grief but also a sense of contamination and anxiety. Whenever possible, an elderly person, preferably one with "ghost power," is hired to prepare and bury the corpse. If it can be managed, the burial takes place the very day of death. His personal property is buried with the dead person. What can not be carried to the grave is destroyed at the home. In a ceremony at the grave the deceased is requested to remain in the land of the dead and is urged to refrain from persecuting his living relatives. The burial party returns by a different route from the one it took to the grave; to do otherwise would be to invite the ghost to follow. After their return, the members of the burial party bathe themselves thoroughly.

Meanwhile the close relatives of the deceased destroy the dwelling in which the

death occurred, burn the property of the dead, destroy any property of their own that was closely associated with the dead person, cut the ends of their hair and allow the rest of it to hang loose, discard their good clothes, and wail. They stay by themselves in semi-isolation for four or eight days. All the dwellings of the encampment are moved for a short distance in the opposite direction from the burial site. The relatives burn sage, scatter ashes, and engage in other practices aimed at keeping the ghost at a distance. If necessary they hire a shaman to conduct a purification rite. Relatives will not utter the name of the dead, and others may not mention the name in their presence. A relative will even refrain for some time from using the kinship term by which he has addressed the deceased.

This studied effort to eliminate any mention of the dead and to destroy any object that would remind one of him has for its purpose the prevention of the return of the ghost. To think of the dead too often, to dream of the deceased, to venture too near a grave, or even to whistle at night "draws" ghosts. And since a person who sees a dead relative is himself doomed to die soon, this is additional cause for terror. It is the practice of ghosts to invite their relatives to join them; they offer food to the living, and if this is eaten, the one who has tasted the food of the underworld must relinquish this life. Therefore, a ghost experience evokes the greatest uneasiness. States of extreme anxiety, fainting, hysterical seizures, and insanity are usually diagnosed as "ghost sickness." The ghosts of witches plague the living through the medium of owls. The hoot of an owl shortly after a death is therefore one of the most ominous and frightening of sounds. In the call of the owl, a Lipan listener hears a human voice and often recognizes the message of a departed relative.

The devastating fear and contamination that ordinarily accompany death are greatly relaxed when the deceased is an infant or a very old person. Apparently, the infant has not yet suffered social injuries that his ghost must avenge; the aged person has presumably shed his grudges as the years have passed over him and as physical weakness has grown upon him.

COMMENTS AND PERSPECTIVE

It has been the dual purpose of this paper to show that a culture about which we have reasonably full information may be systematically examined for the fundamental assumptions or themes that indicate its purpose and direction and to demonstrate that these themes can be used as nuclei around which the significant facts of behavior and belief can be meaningfully grouped.

Still, to list 20 of these cultural affirmations and to devote a page or two to "expressions" or illustrations of the workings of each theme, does not exhaust the possibilities of the approach. A further step, of course, is to trace the interrelations of the themes and the manner in which they augment or limit one another. In Lipan culture, for instance, the theme of the comparative weakness of women is balanced, though not overshadowed, by the theme of woman's social importance. The limiting influence of each of these themes upon the other results in a solution whereby the formal symbols of political power are vested in the men, though the women enjoy economic equality and a large measure of social protection. Also, the acceptance by the culture of the principle of individual choice and individual differences (theme 8) somewhat offsets and relieves the rigidity of the doctrine of predestination in regard to elements of the tribal pattern (theme 7). On the other hand, the three predominant moral–social virtues have undoubtedly been underscored and strengthened by the circumstance that they and not birth or some other condition, have become the criteria of chieftainship.

It is certain that a more sustained and sensitive study of the themes and their expressions, of their interpenetrations, and of the structure and equilibrium that result from their relations is desirable. Such a treatment, however, is more than can be accomplished in a paper of this length; to present the full account of themal organization and dynamics in a culture requires a contribution of monographic proportions. Consequently, as my next major piece of writing, I hope to expand this preliminary

description of Lipan culture to book length and to make the methodological core of the effort a full exposition of the themal approach.

In the course of writing this paper certain questions have arisen in my mind or have been put to me by others, and it may prevent misunderstanding if they are dealt with briefly here.

The first question has to do with the reality, or at least the distinctiveness, of themes. One may ask whether the carrier of the culture is aware of the themes I have described. It is clear that the Lipan is fully cognizant of some of them and quite as explicit in discussing them as I have been. He has no difficulty in telling you that children are particularly vulnerable to dangers, that women are in many respects weaker than men, or that the obligations of the married person to his relatives-in-law are fundamental. On the other hand, I doubt very much that a theme more abstract and philosophical in tone, such as that "security is attained largely through the conquest of fear and danger" could be obtained in just that form from the average Lipan. This does not, to my mind, in any way invalidate the theme. The Lipan does not preen himself upon being a philosopher or a social scientist. He sees no reason why behavior patterns that come to him traditionally and with which he complies easily and naturally should be reduced to least common verbal denominators. That the Lipan would not be likely to utilize an over-all category that classifies the conquest of fear at the time of a power vision with the conquest of physical fear does not exempt the social scientist, whose purposes are quite different, from doing so.

A related and perhaps more important question is whether the existence and character of themes are susceptible to empirical investigation and verification, whether comparable methods and efforts can be expected to yield equivalent results. Would another social scientist, interested in the same approach and the same people, arrive independently at the identical number and statement of themes? Only a test case can settle this with certainty, but my guess is that the results of such investigations by two informed field workers would be comparable. I doubt that many of the themes I have defined would be overlooked by anyone thoroughly familiar with the culture or that they would fail to be recognized for what they are by one who has been schooled in the method and interest. It is likely that another worker would phrase some of the themes differently and perhaps more aptly. It might very well happen that some themes (such as 1 and 2 or 3 and 4) which are now separated, would be combined and that two or more themes would be recognized where I have felt that one would serve (theme 15). But I doubt whether any major shift in the content of the total list of postulates would be likely to occur.

In a friendly and helpful letter, Kurt H. Wolff, of Ohio State University, has asked, among other things, how one can differentiate for certainty between a theme and an expression of a theme. I confess I see no great difficulty here. As I conceive of them, themes are propositions that serve as the stimulus or rationalization for acts and beliefs. The acts and beliefs are the expressions. Consequently, themes can be considered to be the broadest directives of a unified nature implicit in a culture. If an item or a trait has to be explained, validated, or interpreted in terms of another and broader concept, we may be sure that it is no theme.

In another letter, after indicating his interest in the method A. L. Kroeber, of the University of California, made a very pertinent observation which deserves some comment in the light of this experience in applying the theory to a substantial body of data. Dr. Kroeber wrote: "The value of the approach will depend on how great a part of any culture you can apply it to. Picking off a certain number of themes but leaving the great mass of the content of the culture a nonthematic chaos may be stimulating, but will leave the tool not too helpful. If you could attach most of a culture to a series of themes and then group these themes, you would have in hand a method of organization that might well be of fundamental importance. I hope you will try to see how far you can apply the method." With Dr. Kroeber's caution in mind, I was

particularly interested to know whether most of the Lipan material could be identified, without violence to its essential meanings, with one or another of the themes which had been recognized. I believe it is obvious even from the condensed and abbreviated description of Lipan culture offered in this paper, that the results have been extremely gratifying. It will be noted that the range of interests and activities it was possible to subsume under the various themes was wide indeed. There was very little, and certainly very little of importance, which was not dynamically related to one of these themes.

Even if the possibility of analyzing a culture by means of themes is granted, it is only reasonable to ask whether there is any particular advantage to be gained by employing this method rather than some other. Many cultural anthropologists will grant that when we informally discuss the native groups we have studied in the field we are often sprightly and interesting, but when we endeavor to write about these same groups the results are too often labored and uninspired. In our oral attack we are anecdotal and vivid. We emphasize what seemed important. Unconsciously we reach out for themes in terms of which to characterize the culture. In our written efforts, however, we are subdued and restrained by the formula or outline which is the badge of our craft. We have felt obliged to give, more or less mechanically and in this order, the location and geographical setting of the tribe, the essentials of the material culture and economy, the social life, the political life, and the art and religion. The monograph tends to run to flat description, items are arranged rather than weighted, one fact is treated like another. As a result, anthropological monographs, despite essential differences in the cultures portrayed, are in spirit remarkably alike. The unique organization that purpose lends to the culture is lost; the flavor and élan of the culture somehow does not emerge. In my opinion one remedy for this is to deal with subjects as they constitute a force in the culture and not as they appear on a topical outline.

There is another decided advantage to be gained from a cultural analysis based on guiding principles of general interest. Students of comparative cultures, when they are limited to routine description, find themselves in the unfortunate position, as far as the intelligent layman or those outside their field of specialization are concerned, of presenting a quaint but unconvincing picture of unfamiliar behavior in a foreign setting. Those whom we would like to reach can not believe that these oddments may possibly be of significance to them or that those who gather such material can be moved by anything other than an eccentric's interest. Not long ago a college president, who saw no room for social anthropology in his curriculum, asked me if anthropology were not a very "technical" subject. By "technical" he meant esoteric. Recently, too, a social scientist asked me if I could not recommend a cultural anthropologist for his department who was not an antiquarian but who was interested in the problems of our modern society! I suspect that the appalling misapprehensions that these views reflect will persist as long as the culture trait is the measure of anthropological sapience. But I am also convinced that if we subordinate practices to purposes in the treatment of our material, the practices which are the raw data of our discipline will be better appreciated and understood. The person who is told that the Lipan raided their neighbors for horses shrugs his shoulders and fails to see in this fact anything pertinent to his problems, to, for instance, the account of the United Nations difficulties he is following in the daily paper. But if you can show him that the Lipan raided and were raided because they conceived themselves to be enmeshed in a predestined cycle of hostilities from which they saw no way to extricate themselves, he may sense a parallel between this and the periodic catastrophes that he uneasily awaits. Let us help him find the similarities.

The Lipan needed horses, but the manner in which they obtained them was wasteful in the extreme. When they stole them from an alien tribe, the enemy warriors pursued the raiders. Some of the horses tired. Rather than to allow them to fall into

enemy hands for use in continuing the pursuit, the animals were killed. Other animals, though they survived, were irretrievably damaged by the difficult journey. The enemy then staged a raid of retaliation. As a result, more horses were run to death or shot. The men who fought over them were often done to death as well. Each episode added to the mountain of animosity and the vows of vengeance. A respite in which the stock might breed in safety would have made all these Indians rich in horses, but none of them knew how to arrest a process they had come to think inevitable.

Our citizen of a modern state works with feverish energy between wars to create wealth, build cities, and rear children. Every two decades a large share of this wealth is destroyed, cities are razed, and the children are decimated. Each time he rises from the ruins of his cities and his hopes, mutters a phrase he has learned about the inevitability of war and the fighting propensity of man and, like an ant that has been momentarily diverted from its goal, begins anew the creative phase of his constructive–destructive cycle. Just as the Lipan chief occasionally spits into a hole with a representative of an alien people and, thus having symbolically buried the difficulty, prevents a particular battle, our citizen of the modern power creates some inadequate peace organization, a concession to his temporary self-disgust and war-weariness. But neither the Lipan nor the representative of the modern state acts with conviction. Neither boldly challenges the theme and its extensions which are the core of his troubles. Each really believes that no matter how economically wasteful and logically absurd his recurring outbursts are, they are part of a tradition which he is helpless to alter significantly. The citizen of the modern state may require a wider stage for his posturing, and his eruptions may be more expensive and lethal, but he is moved and victimized by a theme which, in essence, is not greatly different from the one to which the Lipan bow. It is at the level of motivation and purpose that the similarities and differences between the behavior and conceptions of men and groups of men need to be explored.

It may be asked, in conclusion, whether the theory of themes that has been developed here is original. I should dislike to think so, for, unless a person possesses a degree of creative ability that I do not claim, such novelty usually means a failure to make the best use of the achievements of forerunners or a lack of appreciation of the work of contemporaries. Anything original that I have done amounts to a synthesizing, refining, and testing of the ideas of others and an attempt systematically to apply the concepts that have resulted to a concrete body of material. To estimate correctly an intellectual debt is a difficult task and one that is certain to leave many worthy creditors unpaid. Here I shall not try to do more than to name a few social scientists of whose contributions to the growth of the views set forth here I am particularly conscious.

The "elementary ideas" and "folk ideas" of Adolph Bastian, which I studied as a student of Prof. Robert Redfield, suggested to me, in spite of their vagueness and mysticism, that the anthropologist has for some time seen the necessity for discovering broadly construed and widely shared convictions which might make more intelligible the manifold particulars of human thought and behavior. Berthold Laufer's little classic, *Some fundamental ideas of Chinese culture*, indicated how vivid, exciting, and understandable a culture can become when it is described in terms of its underlying interests and characteristics by one who knows it intimately. Prof. J. R. Kantor's failure to group what he named "institutions" into larger and more unified wholes weakens his theoretical position, but his insistence on defining an institution as a *stimulus* for cultural conduct directed my attention toward the dynamic aspects of the problem.[6] In a series of brilliant lectures that gifted teacher Prof. Edward Sapir again emphasized for me the importance of common goals, aspirations and purposes by identifying areas of psychological unity as well as areas based on a similarity of material culture. In Prof. Ruth Benedict's work I felt the endeavor to cut through

[6] KANTOR, *An essay toward an institutional conception of social psychology* and *The institutional foundation of a scientific social psychology.*

minutiae to the cultural imperatives that mold and direct behavior and personality, though I could not follow her when she phrased the results psychologically rather than culturally and condensed her conception to the point of characterizing a people in a phrase or by reference to a prevailing mood.[7] Prof. A. R. Radcliffe-Brown's formulation of social structure, social integration, and the forces of opposition and solidarity in society (the last largely derived from Durkheim) have been helpful in working out my view of the "limiting factors," though I do not, of course, follow him in his one-sided enthusiasm for the data of social organization.[8] In my first paper on this subject I acknowledged my debt to the writings of Prof. Talcott Parsons, Dr. William H. Kelly, and Prof. Clyde Kluckhohn. Personal contact with Professor Kluckhohn and the opportunity for discussion with him have been particularly helpful in shaping and clarifying my thinking on this topic. I recognize, in my notion of the equilibrium that is achieved in each culture as a consequence of the interrelation of the themes, the stimulation of the writings and criticism of Dr. Alexander H. Leighton and Dr. Dorothea C. Leighton[9]; they, in turn, acknowledge their debt in respect to this outlook to Dr. Adolf Meyer, of Johns Hopkins University.

The vitality of the theory of themes may be measured not only by the number of able thinkers who have contributed to it but also by the parallel developments in theory which are even now under way. Only a few weeks ago Dr. Edward H. Spicer, of the University of Arizona, mentioned to me that he has been concerned with describing the "value system" of the Yaqui Indians. He had thought of applying the term "foci" to those values or attitudes around which interest is centered in Yaqui society and which seem to stimulate and guide activity. It is not difficult to see the similarity in character and function between my "theme" and Dr. Spicer's "focus."

[7] BENEDICT, *Psychological types in the cultures of the southwest* and *Patterns of culture.*

[8] Lecture notes from Prof. Radcliffe-Brown's course in Primitive Society.

[9] See especially A. H. LEIGHTON, *The governing of men.*

For a second illustration I call attention to a recent book by Prof. Ralph Linton, of Columbia University.[10] In discussing what he calls a "value-attitude system," Professor Linton writes: "A value may be defined as any element, common to a series of situations, which is capable of evoking a covert response in the individual. An attitude may be defined as the covert response evoked by such an element."[11] Except for the restriction implied by the word "covert," we have constructs remarkably close to the theme, its expression, and the themal system. By such "coincidences" as these I am led to believe that what I have tried to present here is nothing individual or personal but an approach that represents a growing and fruitful trend in social theory.

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[10] LINTON, *The Cultural background of personality.*

[11] *Ibid.,* pp. 111–112.

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BOTANY.—*The fern studies of Mirbel.*[1]

C. V. MORTON, U. S. National Museum.

Charles François Brisseau de Mirbel (1776–1854) was a French student of botany, particularly well known for his studies on plant anatomy and physiology. In his younger years he devoted himself to taxonomy also, but his work in this field has been neglected. The present paper is a review of his contributions to our knowledge of pteridophytes.

The original *Histoire naturelle générale et particulière* of George Louis Leclerc, Comte de Buffon (1707–1788), did not contain a special section on plants, nor did either of the two subsequent editions. After the death of Buffon, C. S. Sonnini edited an amplified edition of Buffon, entitled *Cours complet d'histoire naturelle,* in 127 volumes. This edition is severely criticized by French scholars[2] because of the great amount of new material added. It contains a section on plants subtitled *Histoire naturelle générale et particulière des plantes.* This botanical part forms volumes 107 to 124 of the whole work but is usually cited separately. Of it, volumes 1, 2, 4, 5, and 6 are the work of Mirbel, volumes 1 and 2 (107 and 108 of the whole) having been issued separately also, under the title *Traité d'anatomie et de physiologie végétales.* The systematic portion of the work of Mirbel begins with volume 4 (dated 1803), in which the ferns and fern allies appear on pages 61–74. Thirty-three genera (five of them new) are given brief diagnoses, but no species are mentioned. In the introduction Mirbel states that this synopsis of the genera is to be followed by a detailed discussion of the species.

However, Mirbel's fuller treatment did not appear in the same series but in another voluminous work entitled *Suite à Buffon,* which was printed in Paris by Deterville. Fifteen volumes of this work are subtitled *Histoire naturelle des végétaux,* the first two of which are by J. B. Lamarck, the others by Mirbel. This work is rare, and there are apparently only two copies in the United States, one belonging to the Massachusetts Horticultural Society, the other to the University of Illinois. The latter institution has very kindly lent volume 5 (volume 70 of the whole) to the library of the Smithsonian Institution. This volume is also dated 1803.

The rarity of this publication has perhaps contributed to the general neglect of Mirbel's work. It was not available to Christensen when he was preparing his *Index Filicum,* his references having been supplied by Dr. A. Gepp of the British Museum. Also it is to be remembered that original studies published in works of encyclopedic scope are likely to be overlooked or soon forgotten, as witness the new species of fern here published by Mirbel that has not been placed or even indexed up to the present time. The same genera, and *Isoëtes* in addition, are treated as in the preceding work and the generic diagnoses are essentially the same; but in this later work, which Christensen erroneously places first, the discussions are elaborated and many species are mentioned or described. A synopsis of the

[1] Published by permission of the Secretary of the Smithsonian Institution. Received January 28, 1946.
[2] Cf. P. FLOURENS, *Histoire des travaux et des idées de Buffon,* pp. 1–363. 1850.

classification presented in this work follows:

Family 1. Filices.

Division 1.

1. *Ophioglossum* L.

Division 2.

2. *Osmunda* L.
3. *Ramondia* Mirb.
4. *Schizaea* J. E. Smith
5. *Marattia* Swartz
6. *Onoclea* L. (syn. *Gleichenia* J. E. Smith)
7. *Danaea* J. E. Smith

Division 3.

8. *Acrostichum* L.
9. *Riedlea* Mirb.
10. *Polypodium* L.
11. *Cyathea* J. E. Smith
12. *Candollea* Mirb.
13. *Pyrrosia* Mirb.
14. *Davallia* J. E. Smith
15. *Dicksonia* L'Her.
16. *Hymenophyllum* J. E. Smith
17. *Trichomanes* L.
18. *Asplenium* L.
19. *Hemionitis* L.
20. *Darea* Juss.
21. *Adiantum* L.
22. *Belvisia* Mirb.
23. *Blechnum* L.
24. *Pteris* L.
25. *Lonchitis* L.
26. *Vittaria* J. E. Smith
27. *Woodwardia* J. E. Smith
28. *Lindsaea* Dryand.

Family 2. Marsileae.

1. *Pilularia* L.
2. *Lemma* Juss. (syn. *Marsilea* L.)
3. *Salvinia* Juss.
4. *Isoëtes* L.

Family 3. Equiseta.

1. *Equisetum* L.

Mirbel's classification appears odd today in its grouping together in the same genus such diverse species as *Osmunda regalis* and *Botrychium Lunaria*, or *Polypodium vulgare* and *Dryopteris Filix-mas*, but this had long been the conventional treatment, following the highly artificial system of Linnaeus, who grouped all the species of ferns under the 12 genera *Onoclea, Ophioglossum, Osmunda, Acrostichum, Pteris, Blechnum, Hemionitis, Lonchitis, Asplenium, Polypodium, Adiantum*, and *Trichomanes*. No significant advance was made in this classification for 40 years, until in 1793 Sir James Edward Smith established eight new genera, all now well known: *Woodwardia, Vittaria, Davallia, Cyathea, Hymenophyllum, Schizaea, Gleichenia*, and *Danaea*. As may be seen by comparison with the synopsis given above, Mirbel's classification is essentially that of Linnaeus and Smith, with five new genera added. This was undoubtedly a conservative treatment for the time, but not so much so as that of Lamarck and Poiret (*Encyclopédie méthodique*, 1783–1808), wherein all the 444 species then known are squeezed into the 12 traditional Linnaean genera.

The early years of the nineteenth century saw a revival of interest in the ferns. Swartz, Cavanilles, Roth, Bernhardi, Willdenow, and Richard were all describing new genera and species in rivalry with each other. Shortly before 1803 such generally accepted genera as *Athyrium, Polystichum, Aspidium, Diplazium, Lygodium, Botrychium*, and *Tectaria* had been published, but none of these are mentioned by Mirbel, doubtless because publications were slow in being distributed at the time, as is attested by *Lygodium*, which received some seven generic names within three years, i.e., *Lygodium* Swartz (1801), *Ugena* Cav. (1801), *Odontopteris* Bernh. (1801), *Gisopteris* Bernh. (1801), *Ramondia* Mirbel (1802), *Hydroglossum* Willd. (1802), and *Cteisium* Michx. (1803).

Mirbel's work on ferns was overshadowed by that of his more distinguished contemporaries, and his influence on the development of fern classification must be considered negligible. However, the Rules of Botanical Nomenclature require that his new genera be taken into account. This was first done by L. M. Underwood,[3] who regarded three of Mirbel's five genera as valid. Underwood has not been generally followed and, as it appears, rightly so, for some exceptions must be taken to his choice of type species. He arbitrarily typified the genera on the species first cited, but this method has no sanction. No definite rules have been or perhaps can be laid down. The type must be selected on the basis of usage and common sense. It should be the species,

[3] *Review of the genera of ferns proposed prior to 1832*, Bull. Torrey Club **6**: 247–283. 1899.

if any, that the publishing author had foremost in mind, that which is illustrated, or that which agrees best with the generic diagnosis. I give below some notes on the typification of Mirbel's genera. The first two offer no difficulties, since they are based on a single species each. The third is a natural genus also. The remaining two are based on confused concepts and must be typified more or less arbitrarily.

Pyrrosia Mirb. Hist. Nat. Pl. **4**: 70. 1803; Hist. Nat. Veg. **5**: 91. 1803.

This genus is based on a new species, *P. chinensis*, which is identified by Ching[4] with *Acrostichum lingua* Thunb. (1784), a common Chinese species of the genus generally known as *Niphobolus* or, more recently, as *Cyclophorus*. Although it is unfortunate that the well-known name *Cyclophorus* must be abandoned, Ching is justified in taking up the name *Pyrrosia*, for the genus is too small and unimportant to make the conservation of *Cyclophorus* desirable.

Riedlea Mirb. Hist. Nat. Pl. **4**: 65. 1803; Hist. Nat. Veg. **5**: 71. 1803.

This genus contains a single species only, *R. sensibilis* Mirb., based on *Filix mariana Osmunda facie racemifera* Pluk., Mantissa 80, pl. 404, f. 2, 1700. This is the basis also of *Onoclea sensibilis* L. (1753), the type species of *Onoclea* L. Mirbel retains the name *Onoclea* for *O. polypodioides* L. (1771), i.e., *Gleichenia polypodioides* (L.) J. E. Smith, but under the present Rules of Nomenclature this is unjustifiable. His reason for discarding *Onoclea sensibilis* L. is that Linnaeus describes that as having the capsule [i.e., sporangium] 5-valved. The "capsules" of Linnaeus were doubtless the spheroidal, very tightly inrolled fertile leaf segments of *Onoclea*, which in age split irregularly, sometimes into five valvelike segments. The genus *Riedlea* is a straight synonym of *Onoclea* L. and also a *nomen abortivum*.

Ramondia Mirb. Bull. Sci. Soc. Philom. Paris **2**: 179. 1802; Hist. Nat. Pl. **4**: 65. 1803; Hist. Nat. Veg. **5**: 55. 1803.

This genus is founded on two species: *R. scandens* (L.) Mirb., based on *Ophioglossum scandens* L., and *R. flexuosa* (L.) Mirb., based on *Ophioglossum flexuosum* L. It is a synonym of *Lygodium* Swartz, published a year previously.

Candollea Mirb. Hist. Nat. Pl. **4**: 69. 1803; Hist. Nat. Veg. **5**: 86. 1803.

This genus is founded on four species: *Candollea heterophylla* (L.) Mirb. (based on *Acrostichum heterophyllum* L.), *Candollea longifolia* (Burm.) Mirb. (based on *Acrostichum longifolium* Burm.), *Acrostichum lanceolatum* L., and *A. polypodioides* L. New combinations for the last two species under *Candollea* are not technically made by Mirbel, although Christensen so indexes them. Underwood took the first species as type; and therefore, since *Acrostichum heterophyllum* L. belongs to the genus *Drymoglossum* Presl (1836), he took up *Candollea* in place of that name. However, Mirbel's generic diagnosis disagrees with *Drymoglossum* and it seems certain that Mirbel misidentified *A. heterophyllum* L. His plants came from Bourbon and Java, whereas, according to Christensen's revision of the genus, *Drymoglossum heterophyllum* is known only from Ceylon. Mirbel's plant from Bourbon was undoubtedly *Cyclophorus spissus* (Bory) Desv., which was originally described from Mauritius, and that from Java must have represented some other species of *Cyclophorus*. Thus, inasmuch as Mirbel's first species is based on a confused concept, it is obviously not a suitable choice as generic type.

The second species, *Acrostichum longifolium* Burm., from Java, has been considered a doubtful member of *Cyclophorus*, but recently it has been definitely identified by Backer and Posthumus[5] with *Cyclophorus acrostichoides* (Forst.) Presl, a common Asiatic species. *Acrostichum longifolium* Burm. may therefore appropriately be taken as the type of *Candollea*, which thereby becomes synonymous with *Pyrrosia* Mirb. Since these two genera are of the same date, Ching's action in recognizing *Pyrrosia* as the valid name and reducing *Candollea* to synonymy must be accepted by the Rules. The following new combination is necessary: **Pyrrosia longifolia** (Burm.) Morton, based on *Acrostichum longifolium* Burm. Fl. Ind. 228. 1768.

[4] *On the genus* Pyrrosia *Mirbel*. Bull. Chinese Bot. Soc. **1**: 61. 1935.

[5] *Varenflora voor Java*. 1939.

The third species mentioned by Mirbel, *Acrostichum lanceolatum* L., is also a species of *Pyrrosia*, according to Ching the same as *Cyclophorus spissus*. The fourth species, *Acrostichum polypodioides* L., is mentioned by Mirbel as atypical of the genus *Candollea*, which it indubitably is, being, in fact, the common *Polypodium polypodioides* (L.) Watt. It is to be noted that *Candollea* Mirb. antedates the flowering plant genus *Candollea* Labill.

Belvisia Mirb. Hist. Nat. Pl. **4**: 65. 1803; Hist. Nat. Veg. **5**: 111, 114–118. 1803.

Unlike the preceding genus, which is reasonably natural, the present is a meaningless jumble similar to the original *Nephrodium* Michx. or *Gymnogramme* Desv. It consisted of five species that are now considered to represent five genera belonging to three families, as follows:

Acrostichum spicatum L. (=*Hymenolepis* Kaulf., Polypodiaceae).
Acrostichum septentrionale L. (=*Acropteris* Link [i.e., *Asplenium* sect. *Acropteris*], Polypodiaceae).
Acrostichum australe L. (=*Actiniopteris* Link, Polypodiaceae).
Acrostichum digitatum L. (=*Schizaea* J. E. Smith, Schizaeaceae).
Acrostichum siliquosum L. (=*Ceratopteris* Brongn., Ceratopteridaceae).

Christensen lists these species under *Belvisia*, but Mirbel did not technically make any new combinations under this generic name.

Belvisia antedates all the genera cited above except *Schizaea*. Underwood chose the first species cited as type and therefore took up the name *Belvisia* in place of *Hymenolepis* Kaulf. (1824). However, this species is definitely mentioned by Mirbel as atypical of the genus, and it is therefore not available as the type species. Mirbel's description as a whole agrees best with *Ceratopteris*, but it would be most unfortunate to change the name of this genus, which has given its name to a family of ferns. A typification on *Acrostichum australe* would involve adopting *Belvisia* in place of *Actiniopteris* Link. *Schizaea* scarcely agrees with the generic diagnosis. Therefore, it seems best to typify *Belvisia* on the second species cited, *Acrostichum septentrionale* L. This species is now placed in *Asplenium*, as the sole representative of the section *Acropteris*. If this peculiar plant is ever accorded generic rank, *Belvisia* will replace *Acropteris* Link (1833) as the generic name. The justification for this typification is given by the fact that the only illustration of *Belvisia* cited by Mirbel is Lamarck Tabl. Encyl. *pl. 865, figs. 2* and *3*. I do not know what figure 2 may represent, but figure 3 is a fairly good representation of *Acrostichum septentrionale*.

Finally I wish to call attention to one new species published by Mirbel that has been overlooked: *Lindsaea erecta* Mirb. Hist. Nat. Veg. **5**: 126. 1803. The original description is as follows:

Il est une autre espèce de lindsée croissant à l'Isle-Bourbon, qui n'a été décrite par aucun auteur; ses tiges sont traçantes, et jettent, comme la précédente, de distance en distance, des feuilles droites, pennées, à folioles alternes, lancéolées, alongées, étroites et redressées. J'appelle cette espèce lindsée dressée (*Lindsaea erecta*).

From the above description this is apparently a synonym of *Schizoloma ensifolium* (Swartz) J. Smith, a species based on *Lindsaea ensifolia* Swartz (Journ. Bot. Schrad. 1800[2]: 77. 1801), described from Mauritius.

PROCEEDINGS OF THE ACADEMY

48TH ANNUAL MEETING

The 48th annual meeting of the Academy, held in the Auditorium of the Cosmos Club, January 17, 1946, after the 338th meeting of the Academy, was called to order at 10:00 P.M. by the President, JOHN E. GRAF, with 23 persons in attendance.

The minutes of the 47th annual meeting were approved as published in the JOURNAL 35: 230–236. 1945.

The reports of several officers and of the Committees of Auditors and Tellers were read and accepted. These reports are recorded at the end of the minutes.

After the acceptance of the report of the Committee of Tellers, the President declared the following duly elected to the given offices:

HUGH L. DRYDEN, *President*,
F. G. BRICKWEDDE, *Secretary*,
HOWARD S. RAPPLEYE, *Treasurer*,
MAX A. MCCALL and WALDO L. SCHMITT, *Board of Managers to January 1949*.

The Secretary presented for the Affiliated Societies their nominations for Vice-Presidents of the Academy as follows:

Philosophical Society of Washington—FRANCIS M. DEFANDORF
Anthropological Society of Washington—T. DALE STEWART
Biological Society of Washington—FRANK THONE
Chemical Society of Washington—LEO A. SHINN
Entomological Society of Washington—CARL F. W. MUESEBECK
National Geographic Society—ALEXANDER WETMORE
Geological Society of Washington—LOUIS W. CURRIER
Medical Society of the District of Columbia—FREDERICK O. COE
Columbia Historical Society—GILBERT GROSVENOR
Botanical Society of Washington—L. EDWIN YOCUM
Archaeological Society of Washington—Not functioning during the National Emergency
Washington Section of the Society of American Foresters—WILLIAM A. DAYTON
Washington Society of Engineers—FRANK B. SCHEETZ
Washington Section of the American Institute of Electrical Engineers—FRANCIS B. SILSBEE
Washington Section of the American Society of Mechanical Engineers—WALTER RAMBERG
Helminthological Society of Washington—MARIO MOLLARI
Washington Branch of the Society of American Bacteriologists—CHESTER W. EMMONS
Washington Post of the Society of American Military Engineers—CLEMENT L. GARNER
Washington Section of the Institute of Radio Engineers—HERBERT GROVE DORSEY
Washington Section of the American Society of Civil Engineers—OWEN B. FRENCH

The Secretary was instructed by the members present to cast a unanimous ballot for these nominees.

The President, JOHN E. GRAF, announced the recipients of the Academy's Awards for Scientific Achievement for 1945 as follows:

In the Biological Sciences, HENRY K. TOWNES, Bureau of Entomology and Plant Quarantine, in recognition of his distinguished service in the morphology and taxonomy of the insect superfamily Ichneumonoidea.

In the Engineering Sciences, KENNETH L. SHERMAN, Department of Terrestrial Magnetism, Carnegie Institution of Washington, in recognition of his distinguished service in advancing the technique of atmospheric electric measurements.

In the Physical Sciences, ROBERT SIMHA, National Bureau of Standards, in recognition of his distinguished service in the physical chemistry of high polymers and the theory of their physical properties.

The Retiring President, JOHN E. GRAF, appointed Past Presidents HARVEY L. CURTIS and CLEMENT L. GARNER to escort the incoming President, HUGH L. DRYDEN, to the chair. Dr. DRYDEN adjourned the meeting at 10:50 P.M.

The following reports were presented at the meeting:

REPORT OF THE SECRETARY

During the Academy year, January 18, 1945, to January 17, 1946, 23 persons were elected to membership, 21 resident and 2 nonresident. Of these, 13 resident and 1 nonresident qualified for membership, 5 resident accepted membership but have not yet qualified by payment of dues and 1 person declined membership. Three persons, 2 resident and 1 nonresident, elected to membership on January 14, 1946, have not yet been notified of their elec-

tion. Fourteen persons elected to resident membership in the preceding Academy year qualified during the present Academy year just ending. The new members were distributed among the various sciences as follows: 5 in chemistry; 4 each in botany and entomology; 3 each in engineering and physics; 2 each in anthropology and meteorology; and 1 each in bacteriology, biology, geology, mathematics, and zoology.

Four members of the Academy (3 resident and 1 nonresident), having retired from the active practice of their profession, were placed on the retired list of members to enjoy all the privileges of active membership without further payment of dues. Five members (1 resident and 4 nonresident) resigned in good standing.

The deaths of the following five members (2 resident and 3 nonresident) were reported to the Secretary:

MERTON B. WAITE, Washington, D. C., June 5, 1945.
FLORENCE BASCOM, Williamstown, Mass., June 18, 1945.
EDWARD W. BERRY, Baltimore, Md., September 20, 1945.
ELMER O. WOOTON, Arlington, Va., November 20, 1945.
THOMAS BARBOUR, Cambridge, Mass., January 8, 1946.

Of these MERTON B. WAITE was an original member of the Academy.

On January 17, 1946, the status of membership was as follows:

	Regular	*Retired*	*Honorary*	*Patron*	*Total*
Resident.....	432	37	2	0	471
Nonresident...	156	26	16	1	199
Total.....	588	63	18	1	670

The net changes in membership during the past year are as follows:

	Regular	*Retired*	*Honorary*	*Patron*	*Total*
Resident.....	+ 3	+1	0	0	+ 4
Nonresident...	+14	0	0	0	+14
Total.....	+17	+1	0	0	+18

During the Academy year 1945 the Board of Managers held 6 meetings, with an average attendance of 20 persons. The following important matters were considered by the Board:

1. In 1945 the American Association for the Advancement of Science allotted to the Academy $163 for grants, in support of research, to members of the Academy and its Affiliated Societies. This allotment added to allotments in the two preceding years makes a total of $520.50 the Academy now has for research grants. The main purpose of these grants is to aid worth-while research projects that lack adequate means of financial support. A.A.A.S. grants may be used for purchases of equipment and supplies but are not to be used in defraying costs of publication.

In accordance with a motion voted by the Board of Managers at a meeting October 16, 1944, a notice was printed in the November 15, 1944, issue of the JOURNAL calling attention to the A.A.A.S. grants held by the Academy and announcing that the Academy would receive applications for grants in support of research from members of the Academy and its Affiliated Societies. Notices were sent to the Secretaries of the Affiliated Societies and to the local universities. Applications were to be received by the Secretary not later than February 1, 1945. No request for a grant was received from any member of the Academy or Affiliated Society. Undoubtedly, the Board of Managers will in 1946 again invite applications for grants in aid of research.

2. The Academy received a request from the Honorable H. M. Kilgore, Chairman of the Senate Subcommittee on War Mobilization, to testify concerning legislation for the establishment of a National Research Foundation to promote scientific research and development with federal funds. In response to this request the Board of Managers sent a letter supporting the establishment of a National Research Foundation and made some suggestions in connection with Senate Bills 1287 and 1295 upon which the Academy was asked to comment. An appreciative letter was received from Senator Kilgore in acknowledgment of the Academy's letter.

During the Academy year, eight meetings of the Academy were held as follows, beginning with the 331st meeting and ending with the 338th meeting:

On February 14, 1945, CLEMENT L. GARNER, as retiring president presented an address entitled *The utility of geodetic control surveys* (published in this JOURNAL **35**. 1945.)

On March 15, 1945, the 1944 Academy Awards for Scientific Achievement were presented to NORMAN H. TOPPING, National Insti-

tute of Health, for work in the biological sciences; to GALEN B. SCHUBAUER, National Bureau of Standards, for work in the engineering sciences; and to GEORGE A. GAMOW, George Washington University, for work in the physical sciences.

On April 19, 1945, LELAND OLDS, vice chairman, Federal Power Commission, addressed the Academy on *River basin authorities and the new community.*

On May 17, 1945, MARGARET MEAD, executive secretary, Committee on Food Habits, National Research Council, addressed the Academy on *Translating scientific findings into living habits.*

On October 18, 1945, FRED C. BISHOPP, assistant chief, Bureau of Entomology and Plant Quarantine, addressed the Academy on *War insecticides.*

On November 15, 1945, CLAUDE E. ZOBELL, associate professor of marine microbiology and director of the American Petroleum Institute Research Project 43A, Scripps Institution of Oceanography, University of California, La Jolla, addressed a joint meeting of the Geological Society of Washington and the Academy on the *Microbial transformation of petroleum hydrocarbons.*

On December 20, 1945, WILLIAM F. FOSHAG, curator, Division of Mineralogy and Petrology, U. S. National Museum, addressed the Academy on *Parícutin's first year.*

On January 17, 1946, W. M. STANLEY, member, Rockefeller Institute for Medical Research, Princeton, N. J., addressed the Academy on *Recent advances in our knowledge of influenza virus and vaccines.*

All meetings were held in the Assembly Hall of the Cosmos Club with the exception of the May 17 meeting which was held in the Auditorium of the U. S. National Museum.

F. G. BRICKWEDDE, *Secretary.*

REPORT OF THE TREASURER

CASH RECEIPTS AND DISBURSEMENTS

RECEIPTS		
From dues, 1942	$ 5.00	
From dues, 1943	10.00	
From dues, 1944	40.00	
From dues, 1945	2,691.25	
From dues, 1946	30.00	$2,776.25
From JOURNAL, Subscriptions, 1942	$ 6.00	
From JOURNAL, Subscriptions, 1943	11.40	
From JOURNAL, Subscriptions, 1944	41.28	
From JOURNAL, Subscriptions, 1945	373.36	
From JOURNAL, Subscriptions, 1946	490.80	
From JOURNAL, Subscriptions, 1947	2.70	925.54
From JOURNAL, Sales		488.12
From JOURNAL, Reprints, 1944	194.27	
From JOURNAL, Reprints, 1945	469.10	663.37
From Directory, 32d Ed., (1941)		1.00
From Interest & Dividends		1,099.25
From Yetta Korman et al		1,000.00
Total Receipts		$6,913.53
Cash Balance, Jan. 1, 1945		2,244.80
Total to be accounted for		$9,158.33

	1944	*1945*	*Total*
DISBURSEMENTS			
For Secretary's Office	$138.50	$ 211.59	$ 350.09
For Treasurer's Office	35.65	97.89	133.54
For Custodian & Subscr. Mgr.	6.54	—	6.54
For JOURNAL—Printing & Mailing	242.57	2,425.08	2,667.65
For JOURNAL—Illustrations	19.90	428.06	447.96

For JOURNAL—Reprints	60.99	430.82	491.81
For JOURNAL Office—Clerk	20.00	220.00	240.00
For JOURNAL Office—Postage, Binding & Misc.	2.99	16.23	19.22
For Directory—33d Ed.		2.25	2.25
For Meetings Committee	47.15	274.35	321.50
For one $1,000 Series G Bond		1,000.00	1,000.00
For Debit Memos, Refunds, etc.			
For Refund of overpayment, Shapovalov		0.35	0.35
For Refund Dues (1945) E. W. Berry		5.00	5.00
For Refund Dues (1945) H. R. Morgan		5.00	5.00
For Exchange on Canadian Check		0.64	0.64
For Check (Weibe) returned on account more than 6 months old		4.00	4.00
Total	$574.29	$5,121.26	$5,695.55
Cash Balance, Dec. 31, 1945			3,462.78
Total			$9,158.33

RECONCILIATION OF BANK BALANCE

Balance as per cash book, 12/31/45			$3,462.78
Balance as per Am. Sec. & Trust Co. Statement of 12/31/45		$3,677.64	
Receipts not deposited		186.97	
		$3,864.61	
Checks outstanding, not cashed			
No. 1018	$ 5.41		
1086	21.86		
1088	260.92		
1089	104.49		
1090	9.15	401.83	$3,462.78

INVESTMENTS

Washington Sanitary Improvement Co. (stock)		
Certificate No. 434—100 shares at $10	$1,000.00	
Certificate No. 435—100 shares at $10	1,000.00	
Certificate No. 527— 8 shares at $10	80.00	
Certificate No. 539— 1 share at $10	10.00	
Certificate No. 582—200 shares at $10	2,000.00	$ 4,090.00
Potomac Electric Power Co.		
20 shares, 6% preferred stock—cost		2,247.50
City of New York—3% (Transit Unification) (Due—June 1, 1980)		
Certificate No. D 20186	500.00	
Certificate No. C 71038	100.00	
Certificate No. C 71039	100.00	
Certificate No. C 71040	100.00	800.00
Chicago Railways		
Bond No. 1027—5% Registered for $1,000.00 Due Feb. 1927—$250.00 paid—Bal.		750.00
First Federal Savings & Loan Assn.		
Certificate No. I— 914	$4,000.00	
Certificate No. I—1063	1,000.00	$ 5,000.00
Northwestern Fed. Savings & Loan Assn.		
Certificate No. 1380	$4,500.00	
Certificate No. 1441	500.00	5,000.00

United States Government			
Series G Bonds—No. M 332990	G(1/42)	$1,000.00	
M 332991	G(1/42)	1,000.00	
M 332992	G(1/42)	1,000.00	
M 332993	G(1/42)	1,000.00	
M 1808741	G(10/43)	1,000.00	
M 2226088	G(2/44)	1,000.00	
M 2982748	G(10/44)	1,000.00	
M 4126041	G(10/45)	1,000.00	8,000.00
American Security & Trust Co.			
Savings Account			46.87
Total			$25,934.37
Cash Book Balance			3,462.78
Total			$29,397.15
Total Assets Dec. 31, 1944		$28,179.17	
Total Assets Dec. 31, 1945		29,397.15	
Increase		$ 1,217.98	

HOWARD S. RAPPLEYE, *Treasurer*

REPORT OF THE AUDITING COMMITTEE

The accounts of the Treasurer of the Washington Academy of Sciences for the year 1945 were examined by your auditing committee on January 11, 1946. The report of the Treasurer was checked with due care and was found to be in agreement with his records. The disbursements were all found to be duly authorized and to be supported by cancelled checks or by debit memoranda except for the few outstanding checks noted in the report. The securities of the Society were inspected and found to agree exactly with the list given in the report and to have all coupons attached that are not yet due.

The work of the committee was greatly simplified and lessened by the excellent manner in which the records have been kept and by the systematic and orderly arrangement of the books and of the report. Your Treasurer deserves the commendation of the Society for another year of outstanding service. It should be noted that owing to the difficulty of obtaining adequate assistance he has done a great deal of his own clerical work and has thus effected an appreciable saving for the Society.

C. H. SWICK, *Chairman.*
C. P. CLAUSEN
T. D. STEWART.

REPORT OF THE BOARD OF EDITORS

Volume 35 of the JOURNAL was intermediate in size between that of 1943 and 1944. Certain of the trends noted during 1944 continued during this year. It is believed that they may lead toward a JOURNAL with a better balance of different subjects, especially as soon as the physical sciences are again more adequately represented. Volume 35 consisted of 12 issues and contained 408 pages distributed among the sciences and compared with 1944 as shown in the table:

Sciences	No. papers 1945	No. pages 1945	Percentages by pages 1945	No. papers 1944	No. pages 1944	Percentages by pages 1944
Biological	42	218.0	53.4	40	198.2	47.6
Physical	2	28.7	7.1	3	35.9	8.6
Anthropological	11	97.3	23.8	12	105.6	25.4
Geological	4	22.0	5.4	5	13.8	3.3
Medical	1	3.3	0.8	2	22.5	5.4
Economic	—	—	—	1	2.8	0.7
Obituaries and Proceedings	—	34.7	8.5	—	33.2	8.0
Index	—	4.0	1.0	—	4.0	1.0
Totals	60	408.0	100.0	63	416.0	100.0

This volume includes the addresses of the retiring presidents of the Academy, the Philosophical Society, and the Geological Society; also the 13th Joseph Henry Lecture of the Philosophical Society.

The decline from 63 papers printed in 1944 to 60 printed this year is probably not significant except as it reflected a tendency of scientists to relax momentarily during the latter part of the year as a natural reaction from the tense working during the war years. We again call attention to the large number of papers presented by nonmembers of the Academy. Of the total of 60 papers presented only 32, or 53 percent, were presented by members of the Academy. This should be a challenge to our members. In several cases nonmembers presenting papers for publication were later elected members of the Academy.

The editors are pleased to report continued small increases in the number of illustrations, 25 halftones and 51 line cuts appearing in this volume. A well-chosen appropriate illustration is often as valuable to the reader as several pages of text.

As has been indicated in some previous annual reports, the placing of papers under such labels as Biological, Geological, Anthropological, and General is somewhat arbitrary. Although other editors might make a somewhat different assignment of labels for some of the papers, this is not of great significance. It is obvious that there is a predominance of biological papers, and that the physical sciences and geology are not adequately represented partly because so many engaged in the physical sciences and geology have been working on problems "restricted for reasons of security." It is pleasing to note the continued receipt of papers under the general classification of anthropology (ethnology, linguistics, etc.).

The editors have had some unusual conditions during the year, and it is obvious that the editors for this next year may also have abnormal conditions confronting them. Our contract with the printer provides that increases in the schedule of wages shall be passed on to the JOURNAL. With the increase in the cost of living this may at any time mean an increase in printing cost. About the middle of the past year it seemed quite possible that the end of the fighting might mean an increase in the number of papers and thus an increase in the size of the JOURNAL. Our experience during the closing months of 1945 was that many scientists who might have been authors of papers for a short time took life somewhat more easily than during the strenuous years of the war and did not submit papers for the JOURNAL. For these reasons the editors did not use all the funds available. The recommendation is made, however, that no decrease be made in the appropriations for the JOURNAL for the ensuing year. As illustrations, tables, and mathematical formulae often are used to replace paragraphs and even pages of descriptive matter, their use should be encouraged rather than discouraged by charging the author for excess illustrations and for excess typesetting charges made by the printer. It is recognized that at present the JOURNAL could not be expected to accept an unlimited number of illustrations for printing without charge, but the editors believe that the appropriation should be sufficient to provide for a more liberal policy with regard to illustrations, tabular material and the like than has been possible during recent years.

The Board of Managers appropriated to the editors for printing, illustrating, and mailing the JOURNAL and for other incidental items $3,200; for clerical assistance $240; for postage and incidentals $50—a total of $3,490. Of this sum the total amount of $240 was expended for clerical assistance; and postage and incidentals cost $18.80. Printing, illustrating, and mailing the JOURNAL cost $3,139.68. To this must be added $13.24 representing the cost to the Academy of free reprints of obituaries. The total paid out is thus $3,152.92. From this figure there is to be subtracted $265.59, the amount charged authors for excess illustrations, excess typesetting charges, and exceptional galley changes, leaving $2,887.33, or about $300 less than the appropriation.

The figures given above are not the final ones for volume 35, but are probably not far from correct.

The editors acknowledge with appreciation and thanks the assistance to the JOURNAL in many ways of Mr. PAUL H. OEHSER, editorial assistant, whose experience in editorial work for scientific publications is of great benefit. He has been unsparing of his time in working for this JOURNAL. The editors also acknowledge

the assistance of the associate editors and thank all who have assisted in any way.

LEWIS V. JUDSON
HARALD A. REHDER
WM. N. FENTON

REPORT OF THE CUSTODIAN AND SUBSCRIPTION MANAGER OF PUBLICATIONS

SUBSCRIPTIONS:

Nonmember subscriptions in the United States	118
Nonmember subscriptions in foreign countries	43
Inactive nonmember subscriptions in foreign countries (estimated)	20
Subscriptions, Geological Society of Washington	13

INVENTORY OF STOCKS AS OF DECEMBER 31, 1945:

Reserve Sets of the JOURNAL:	
Bound Volumes 1–29 and unbound Volumes 30–35	1 set
Unbound Volumes 1–35	3 sets
Unbound Volumes 11–35	6 sets
Unbound Volumes 16–35	11 sets
Miscellaneous numbers of the JOURNAL	19,451
Proceedings of the Washington Academy of Sciences Volumes 1–13, inclusive	50 sets

In 1939 the Board of Managers directed the Custodian of Publications to set aside 8 complete sets of the JOURNAL from Vol. 1 to current volume 35; 6 additional sets from Vol. 11 to current volume 35; 11 additional sets from Vol. 16 to current volume 35. These sets were to constitute the Reserve Sets and were to be sold only as a complete set. Subsequently it has been possible for the Custodian to assemble two complete sets from some of the early numbers, especially those between Vols. 1 and 10, donated to the Academy by various members. These early numbers are becoming far more difficult to obtain, either through gifts or by purchase.

Since 1939 six reserve sets have been sold. A request was received on January 14, 1946, for the purchase of another complete set, which will leave us with only three complete sets.

In addition to the above reserve sets a miscellaneous series of volumes and separate numbers of the JOURNAL, consisting of 19,451 numbers is maintained for sale. Complete sets of the Proceedings of the Academy, Vols. 1–13 (1899–1911), together with Directories, are also available for sale.

Most of these numbers and volumes, including four complete sets from Vols. 1–35, are stored, without cost to the Academy, in the Smithsonian Institution and the U. S. Coast and Geodetic Survey. Some of the volumes from Vols. 23–35 are housed by the George Banta Publishing Co., at Menasha, Wis.

SALES AND EXPENDITURES:

During the year 1945 one reserve set was sold to the University Library, Lund, Sweden. Approximately 200 separate numbers of the JOURNAL were sold to various individuals and libraries.

Sales	
1 Reserve Set	$210.00
Net sales of miscellaneous numbers	100.12
Total sales	$310.12
Expenditures	
Postage and office expenses	$ 11.85
Express charges for shipment of Reserve Set to New York City	2.80
Total expenses	$ 14.65
1945 Budgetary allotment	$ 75.00
Expenditures for 1945	14.65
Balance	$ 60.35
Net gain for the year 1945	$295.47

F. M. SETZLER, *Custodian and Subscription Manager of Publications.*

REPORT OF THE COMMITTEE OF TELLERS

A total of 262 envelopes were delivered to the Committee by the Secretary.

The count of valid ballots showed the following elected:

President, HUGH L. DRYDEN,
Secretary, F. G. BRICKWEDDE,
Treasurer, HOWARD S. RAPPLEYE,
Board of Managers to January 1949, MAX A. MCCALL and WALDO L. SCHMITT.

H. F. STIMSON, *Chairman*
GALEN B. SCHUBAUER
KENNETH L. SHERMAN.

Submitted by F. G. BRICKWEDDE, *Secretary.*

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VOL. 36 JUNE 15, 1946 No. 6

SMITHSONIAN INSTITUTION
JUN 17 1946
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JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

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Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, publishes: (1) Short original papers, written or communicated by members of the Academy; (2) proceedings and programs of meetings of the Academy and affiliated societies; (3) notes of events connected with the scientific life of Washington. The JOURNAL is issued monthly, on the fifteenth of each month. Volumes correspond to calendar years.

Manuscripts may be sent to any member of the Board of Editors. It is urgently requested that contributors consult the latest numbers of the JOURNAL and conform their manuscripts to the usage found there as regards arrangement of title, subheads, synonymies, footnotes, tables, bibliography, legends for illustrations, and other matter. Manuscripts should be typewritten, double-spaced, on good paper. Footnotes should be numbered serially in pencil and submitted on a separate sheet. The editors do not assume responsibility for the ideas expressed by the author, nor can they undertake to correct other than obvious minor errors.

Illustrations in excess of the equivalent (in cost) of one full-page halftone are to be paid for by the author.

Proof.—In order to facilitate prompt publication one proof will generally be sent to authors in or near Washington. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Unusual cost of foreign, mathematical, and tabular material, as well as alterations made in the proof by the author, may be charged to the author.

Author's Reprints.—Reprints will be furnished in accordance with the following schedule of prices (approximate):

Copies	4 pp.	8 pp.	12 pp.	16 pp.	20 pp.	Covers
50	$2.00	$3.25	$ 5.20	$ 5.45	$ 7.25	$2.00
100	2.50	4.00	6.40	6.75	8.75	2.75
150	3.00	4.75	7.60	8.05	10.25	3.50
200	3.50	5.50	8.80	9.35	11.75	4.25
250	4.00	6.25	10.00	10.65	13.25	5.00

Subscriptions or requests for the purchase of back numbers or volumes of the JOURNAL or the PROCEEDINGS should be sent to FRANK M. SETZLER, Custodian and Subscription Manager of Publications, U. S. National Museum, Washington 25, D. C.

Subscription Rates for the JOURNAL.—Per year $7.50

Price of back numbers and volumes:	*Per Vol.*	*Per Number*
Vol. 1 to vol. 10, incl.—not available.*	—	—
Vol. 11 to vol. 15, incl. (21 numbers per vol.)	$10.00	$0.70
Vol. 16 to vol. 22, incl. (21 numbers per vol.)	8.00	0.60
Vol. 23 to current vol. (12 numbers per vol.)	7.50	0.90

* Limited number of complete sets of the JOURNAL (vol. 1 to vol. 35, incl.) available for sale to libraries at $303.50.

PROCEEDINGS, vols. 1–13 (1899–1911) complete $25.00
Single volumes, unbound 2.00
Single numbers ..... .25

Missing Numbers will be replaced without charge provided that claim is made to the Treasurer within 30 days after date of following issue.

Remittances should be made payable to "Washington Academy of Sciences" and addressed to the Treasurer, H. S. RAPPLEYE, U. S. Coast and Geodetic Survey, Washington 25, D. C.

Exchanges.—The Academy does not exchange its publications for those of other societies.

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JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 36 JUNE 15, 1946 No. 6

ETHNOLOGY.—*Some Eastern Cherokee bird stories.*[1] JOHN WITTHOFT, University of Pennsylvania. (Communicated by W. N. FENTON.)

The following stories, a series of tales collected during the course of ethnological field work among the Cherokee of Qualla Reservation, North Carolina, in the winter and summer of 1944–45, are representative of Cherokee bird lore. They are a portion of an extended body of Cherokee tales about animal life. The majority are new versions of stories previously published. Nevertheless, important variations occur and seem worthy of being placed on record. Some of the variant features are no doubt due to changes that have taken place since the time that the earlier published series were collected, yet it seems probable that many of the diversities were in existence prior to that time and may represent differences in the traditions of various localities and even of various families or larger groups. A more careful collection of tales from the other communities of the Eastern Cherokee and of the Oklahoma Cherokee would perhaps permit the comparison of variants of the more common tales and might lead us to more definite conclusions as to the amount of time involved in literary change of this sort among the Cherokee. More important, the comparison of data derived from folk-tale sources, with data from studies emphasizing linguistics, ceremonial life, material culture, and similar fields, from various localities, might help us to delimit and describe the various streams of tradition that have survived among existing Cherokee communities.

[1] This study was made possible by a grant-in-aid, for field work among the Eastern Cherokee, from the Department of Anthropology Research Funds of 1944 and 1945 of the University of Pennsylvania. Received February 7, 1946.

The stories presented were obtained from three of the more conservative informants, Will West Long and Mollie Sequoyah, of the Big Cove community, and Moses Owl, of Birdtown. Further study in these two localities and in the other Eastern Cherokee communities would probably uncover more tales, if the bird subject were given specific attention.

THE BIRD THAT SAYS "SOMEBODY'S COMING!" AND THE BIRD THAT LIES[2]

Once an old woman lived all by herself in a cabin in the woods. Children used to go there to visit her because she gave them all sorts of good things to eat. She would coax them to her house with flattery and dainties, and they would eat and play in her yard. Sometimes she would admire a child, and say, "You have such beautiful hair. Come here and let me see it." Then she would play with the child and run her fingers through his hair and lead him off. No one would ever see the child again.

When this had happened several times, the people went to some of the conjurors, who dis-

[2] This story is one of a class of Liver-eater and Stone Coat stories, all of which are variants of a most important theme in Cherokee mythology. The Stone Coat is the legendary source of a large portion of the medical and magical lore of the Cherokee and the source for the conjuror's magical stones. The stories of the Liver-eater in most versions show close resemblances to the Stone Coat story and have either been derived from it or have become confused and blended with it. Some of these versions appear in the following places: MOONEY, JAMES, *Myths of the Cherokee.* 19th Ann. Rep. Bur. Amer. Ethnol.: 316, 319, 466, 469. 1900; MOONEY, JAMES. *Cherokee and Iroquois parallels.* Journ. Amer. Folklore **2**: 67. 1889; TERRELL, JAMES W., *The demon of consumption. A legend of Cherokees in North Carolina.* Journ. Amer. Folkore **5**: 125–126. 1892 (badly mutilated version of Liver-eater); TEN KATE, H., *Legends of the Cherokees.* Journ. Amer. Folklore **2**: 54. 1889.

JUL 17 '46

covered that this woman was a witch. They said that she plunged her abnormally long index finger into the child's throat just above the collar bone and drank its blood. The people gathered together to kill her, in accord with old Cherokee law.

This old woman expected that the people would come to kill her, so she kept two birds, which stood watch to warn her if anyone approached. One of these birds was the tc'ik'alili' (chickadee, *Penthestes atricapillus*), and the other was the u'dz'uga', "crest" (tufted titmouse, *Boeolophus bicolor*), just like the chickadee but larger. This larger bird liked to play tricks, and so he would perch on her shoulder and say "Somebody's coming!" for a joke. When he had fooled the old woman several times, she became angry and said, "All right, I'm going to teach you a lesson. I'm going to punish you for playing tricks and turn you loose to look after yourself." So she pulled his tongue out and cut it off and then drove him away. Thus he became known as the bird that lies, and he still has only a little stump of a tongue.

When the people finally did come to kill the witch, the chickadee warned her, but now she thought he was lying too. While she was threatening him, the people came in and took her by surprise. She was trapped, and so she ran into the fireplace and jumped out through the low chimney-hole, turning herself into a bird to escape.

She became the tsulyena', "deaf" (the yellow-bellied sapsucker, *Sphyrapicus varius*, here called "red-headed woodpecker"). She still wears the red bandanna that she had on her head. She was very old and deaf, so the bird is still deaf, depending entirely on its eyes to warn of the approach of humans. She is still running away from people, and so the bird watches you from behind a tree trunk when you meet her in the woods.[3]

THE GIRL WHO MARRIED THE "YELLOW NIGHTINGALE"[4] (Mollie Sequoyah)

Once a strange young man appeared at a Cherokee house and stayed for several days. He fell in love with his host's daughter and asked permission to marry her. The old people were cautious about entrusting their daughter to a stranger, but he assured them that he was a hard-working farmer and would make a good, dependable husband. They agreed to the proposal, and the young people were quickly married.

Soon after they were married, the young man began to prepare ground to make a crop. One morning he took the team to his field to plow and was not back home yet when his wife had dinner ready that evening. She went to call him but could only find the team, waiting to return home, with a little bird perched on the plow. She thought nothing of it and went back home, where he soon appeared.

The next day he went out to plow again. About noon his wife decided to take some corn bread and hominy juice (a favorite Cherokee beverage) to him for lunch. When she arrived at the field she could find no trace of her husband, but the team was working without him, directed only by a bird who sat on the fence calling out orders to them, "Hoo, hoo, hu, hu." This bird was the huhu (yellow-breasted chat, *Icteria virens*, locally called "yellow nightingale").

The girl now realized that her husband was only a bird. She hurried home without being seen. When her husband arrived that evening she drove him away, saying, "I don't want you; you're only a huhu and not a man at all. Go back to the swamp." So he left and has lived in the swamps ever since.

HOW THE BOBWHITE GOT HIS WHISTLE[5] (Mollie Sequoyah)

When the rabbit had been beaten in his race with the turtle, by the turtle's ruse of posting his relatives along the track, the rabbit became angry and decided to get even with the turtle. Soon he met the bobwhite (ogugwe', *Colinus virginianus*, locally called partridge) and had a good idea. The bobwhite, unlike most birds, had no whistle, and he rather envied the birds who did. The rabbit told him, "You know, the turtle has a very pretty whistle, and it isn't much use to him. Why don't you go borrow it

[3] MOONEY, JAMES, *Myths of the Cherokee:* 281, calls the nuthatch "deaf" (tsulie'na), but my informants pointed out the yellow-bellied sapsucker as this bird.

[4] MOONEY, JAMES, *Myths of the Cherokee:* 281, gives a somewhat different version of this tale.

[5] MOONEY, JAMES, *Myths of the Cherokee:* 289, gives a shorter account of this story. The story "Why turtle's shell is cracked," here referred to, has been published by Mooney, *Myths of the Cherokee:* 279.

from him." The bobwhite understood what he meant and said, "Do you really think he'd let me borrow it?" The rabbit assured him that it could be done, and so the bobwhite went on his way looking for the turtle.

After a while the bobwhite met the turtle along the road, whistling as he went. "Well, well," said the bobwhite, "what a nice whistle you have. Will you let me see it?" The turtle, flattered, showed his whistle to the bobwhite. "That's a very nice whistle," said the bobwhite, "Won't you let me try it for just a minute?" "Well," said the turtle, flattered but cautious, "I might. But be careful and don't lose it. I need it very badly. When I'm traveling alone, rolling downhill, sometimes I get stuck on my back, and then I have to whistle to my relatives to come and turn me over. When I rolled over a cliff and broke my shell to pieces, I'd have died if my relatives hadn't come to carry me home. So be very careful of my whistle; it's very important to me."

The bobwhite took the whistle and tried it. It felt so good to be able to use such a whistle, like other birds. "Could I try it a little while I'm flying?" he asked. The turtle agreed but warned him not to go too far. The bobwhite flew around the turtle's head for a few minutes and then he flew up the road a little way. "Hey, come back," the turtle yelled. The bobwhite came back and asked if he could fly around a little more with the whistle. He felt so good with such a nice whistle. Finally he flew away and never came back. Ever since, the bobwhite has had the turtle's whistle, and the turtle has had no voice at all.

HOW THE TURKEY GOT HIS RUFF AND THE TURTLE HIS JEWELS[6] (Mollie Sequoyah)

Soon after the rabbit had helped cheat the turtle of his whistle, he met the turkey on the road. "What nice beads you have," he told the turkey. "They're all right," said the turkey, "but they're so small and not very pretty." "The turtle's wife has a very pretty necklace; why don't you trade with the turtle?" said the rabbit.

Shortly after, the turkey met the turtle, and said, "Look at these jewels I have." The turtle admired them, and the turkey talked about them so much that the turtle thought that they were something really valuable. "Why don't you trade with me for them?" the turkey asked. The turtle said he didn't have any jewelry at all, so how could he trade? But the turkey said that he would give the jewels to him in exchange for his wife's necklace, and then the turtle and his wife could both wear beads, as there would be enough for both. So the turtle ran home and got his wife's necklace, and traded with the turkey. Ever since then the turkey has worn the turtle's wife's grand necklace of ruffs, and the turtle and his wife have had to be content with the beads, which can still be seen in the round colored markings on the turtle's neck.

HOW THE BUZZARD BECAME BALD[7] (Mollie Sequoyah)

Once the buzzard (Su'li,[8] turkey buzzard; *Cathartes aura*) had beautiful feathers and a crest on his head and was a very proud bird, who would not stoop to eating carrion, but only fresh-killed meat. There came a time when he had almost nothing to eat. A cow (Mooney's version, loc. cit., involves a buffalo), annoyed by the buzzard's pride, decided to play a trick on him. The cow lay down near where several other cows had died some time previously, and waited for the buzzard. Finally the buzzard saw the cow and flew down and began to tear at the cow's hindquarters. The cow just lay there and played dead, until the buzzard thrust his head into the anus of the cow and so was caught. Strangling, the buzzard pulled very hard and got free, but his crest and all the feathers on his head were torn out. Ever since, the buzzard has been bald, and has lost

[6] MOONEY, JAMES, *Myths of the Cherokee:* 287, has a closely related tale, "How the turkey got his his beard."

[7] MOONEY, JAMES, *Myths of the Cherokee:* 293, refers to this story. The same tale is recorded for central Algonkian tribes as a portion of the Nanabus cycle in the following references: SKINNER, ALANSON, *Plains Ojibwa tales.* Journ. Amer. Folklore **32**: 282. 1919; SKINNER, ALANSON, and SATTERLEE, JOHN V., *Folklore of the Menomini Indians.* Amer. Mus. Nat. Hist. Anthrop. Papers **13** (3): 202–203. 1915.

[8] Su'li is likewise the Creek (Muskhogian) term for the buzzard, according to LOUGHRIDGE, R. M., and HODGE, D. M., *Muskogee dictionary:* 12. 1890. JAMES MOONEY (*Myths of the Cherokee:* 239, 430) tells of the buzzard's role in shaping the mountains, according to one Cherokee tale, and points out that this role is exactly the same that the buzzard performs in Creek and Yuchi mythology, thus giving us another link with the mythology of the Cherokee's southern neighbors.

all his pride, so that now he eats only spoiled meat and is careful to remove the eyes of a carcass first, to make certain that it is dead.

OWLS

Among the Eastern Cherokee the owls, and incidentally other night birds, are generally regarded as messengers foreboding disaster. Especially the long-eared owl[9] (*Asio wilsonianus*) is considered to be a metamorphosed witch, who comes in that guise to steal the life of a weak or sick person and so prolong his own life. The witch also comes as a spy, or to do other evil. But this is only an owl-imitator, not a real owl, and does not mean that every owl is a witch, but that each owl heard around the house at night may be such an evil spirit and may incite terror in the hearts of the family. Such an owl, however, is probably more often considered as a bad omen, foretelling possible misfortune.

A serious house fire on the reservation some time ago resulted from a defective flue, but the next morning a dead screech owl was found perched at the top of the chimney. One person was heard to conjecture that the origin of the fire was clear, and it was intimated that the owl had been sent to do damage to the owner.

Many of the Cherokee, however, are not inclined to accept the owl as a witch, or to interpret the screaming owl that stays near the house as anything but an omen and a warning. According to Mollie Sequoyah, "Some people say that owls are witchy, but it isn't true. They only come to warn you when you're going to have trouble." Maude Welch says that an owl, nighthawk, or whippoorwill calling around the house at night is a sign of sickness or death. Will West Long says that, traditionally, if an owl called around the house for four successive nights, it was a sign that someone was going to die, at least within three years. Will states that witches are apt to come as any night animal or bird, the dread "raven-imitator" being the worst, and the owl-imitator being one of the least potent witches; according to Mollie Sequoyah they are apt to come as hawks or as night animals or birds. Apparently the owl is only one of the various guises that a witch may assume.

The most interesting account of the supernatural nature of the owl is that given by Will West Long.

THE OWL AND THE FIRE

The fire of the Indians (not the fire of white people, made with matches, but the old traditionally preserved "real fire" of mythological origin and the periodically rekindled "new fire" of the Cherokee) is an old woman (according to Will West Long, called virtually "old woman" akayᵠ'li·kᵠ and "white or peaceable woman" akayᵠ'-linɛ'gα, while ordinary fire is atsi·la'' or a'ti·la'). She needs to be fed, just as people do. The Cherokee were accustomed to offer some of each meal to the fire, and when the pot boiled over they would say, "The fire wants to drink." All native foods must be offered to the fire, but not pork, white bread, and such introduced foods.

If one neglects to feed the fire, she comes at night in the guise of an owl or a whippoorwill and cries for proper treatment and threatening vengeance. If not satisfied then, she will cause sickness or death in the household. To prevent this, bread and meat must be thrown on the fire for four successive nights, while the proper traditional formula is repeated, and the owl or whippoorwill will be satisfied and leave. Especially, one must not kill or injure the bird.

Once the bird spoke to the people. It said, "You families! When I screamed up on the mountain, you hated me. Don't you know, I was only warning you that something would happen because you didn't feed me. The owl in the woods is the same as the fire on the hearth."

[9] The long-eared owl, *Asio wilsonianus*, is called s'ki·li', onamotopoeically, but s'ki·li' is also one of two names for a witch and is said to mean "Something bad or ugly looking," according to Will West Long. According to James Mooney (*Myths of the Cherokee:* 284) the name for this owl means witch.

BIOPHYSICS.—*Nouvelles recherches relatives aux propriétés optiques de l'os: La biréfringence de l'os minéralisé; Relations entre les fractions organiques et inorganiques de l'os.*[1] M. J. DALLEMAGNE et J. MÉLON, Université de Liége.
(Communicated by FRANK C. KRACEK.)

INTRODUCTION

La connaissance détaillée des propriétés physiques de l'os peut nous permettre d'éclaircir de nombreux problèmes restés sans solution jusqu'à présent. Ceux-ci concernent aussi bien la nature des constituants organiques et minéraux que leur mode de groupement respectif.

Au point de vue de leur nature, la qualité chimique des microcristallites minéraux n'est plus entièrement du domaine de l'hypothèse; nous savons que leur constituant principal est le phosphate tricalcique α et non l'hydroxylapatite ou la carbonato-apatite comme beaucoup d'auteurs s'étaient crus autorisés à le déduire des spectres de diffraction des rayons X (4.5.6.). Il reste toutefois, en ce qui concerne les éléments minéraux de l'os, des questions de détail à résoudre, particulièrement l'état chimique moléculaire du magnésium, du sodium et du potassium: des travaux en cours nous offrent à leur sujet des perspectives intéressantes. Par contre, la fraction organique de l'os est encore très mystérieuse: en effet, nous ne connaisson pas encore les relations exactes existant entre la molécule d'osséine et celle de gélatine. On ignore également s'il existe entre l'osséine et les phosphates des rapports dépassant le domaine de la physique: la question d'une combinaison organo-minérale a été soulevée plusieurs fois, mais n'a jamais reçu de support expérimental concluant. Stella (15) admet la possibilité d'une liaison d'ordre chimique entre l'osséine et les sels osseux. D'autre part, Antoniani et Usuelli (2), étudiant la mise en solution de l'os total, font remarquer que les phénomènes observés par eux relèvent des lois de la chimie colloïdale: ils en infèrent que les sels osseux sont combinés à l'osséine.

Enfin, Caglioti (3) démontre par la méthode de diffraction des rayons X que le microcristallite de phosphate osseux dont l'axe optique est disposé parallèlement aux chaînes polypeptidiques de l'osséine, correspond par sa longueur à deux radicaux d'amino-acides constitutifs de celle-ci. Cet auteur considère que l'intrication des réseaux minéral et organique est tellement régulière qu'elle pourrait faire admettre l'existence d'une combinaison. Nous croyons pouvoir trouver matière à confirmer ou à infirmer ces conclusions dans l'étude des caractères optiques des deux réseaux.

Au point du vue purement physique, la structure submicroscopique de l'os n'est pas encore connue avec le détail désirable: nous possédons quelques données éparses qu'il est nécessaire de contrôler, de coordonner et surtout de compléter. Les méthodes physiques d'investigation que nous utilisons, relevant surtout de l'optique cristalline avec toutes les ressources de ses procédés expérimentaux, nous offrent la possibilité de pénétrer plus avant dans le domaine de la chimie et de l'architecture moléculaire osseuse. Elles ont déjà rendu de grands services à l'étude des systèmes dispersés colloïdaux: or, à plus d'un point de vue, par la nature même de son substrat organique, l'os fait partie du domaine colloïdal. Le chercheur qui entreprend de telles études trouve d'ailleurs dans l'os un matériel de choix à cause de l'organisation moléculaire même de ce tissu: celle-ci peut singulièrement faciliter la résolution des problèmes qui se posent.

Le présent travail, basé sur un certain nombre de données établies antérieurement, tout en formant par lui-même un ensemble expérimental complet, ne rend compte que d'une étape de nos recherches; celle-ci a plus spécialement pour objet les propriétés optiques de la fraction minérale de l'os. De plus, il ne se limite pas aux questions relatives aux microcristallites minéraux et à leur groupement architectural, il touche d'autres territoires d'investigation, surtout celui de l'osséine, et en ce sens, il constitue la base de recherches que nous poursuivons actuellement. Celles-ci permettent l'espoir de faire connaître la struc-

[1] Received December 20, 1945.

ture submicroscopique de l'os avec des détails nouveaux: en même temps, elles apportent des confirmations précieuses aux faits déjà établis par nous-mêmes au sujet de la nature chimique de l'os.

BASES THÉORIQUES DES RECHERCHES
DÉFINITION DE LA BIRÉFRINGENCE

Ce travail ayant pour objet l'étude des propriétés optiques de l'édifice cristallin minéral enrobé dans l'osséine et tout particulièrement de sa biréfringence, il nous semble indispensable de rappeler la définition et les bases théoriques de cette dernière.

Un rayon lumineux tombant sur un cristal le traverse et en sort dédoublé, mais ces deux rayons sont polarisés à angle droit. Les vibrations lumineuses de ces derniers se produisent donc dans deux plans différents orientés à 90° l'un de l'autre. De plus, les deux rayons polarisés ne se propagent pas dans l'épaisseur du cristal à la même vitesse et celle-ci n'est pas la même que dans l'air. Le rapport entre la vitesse de passage de la lumière dans l'air et celle de son passage dans un corps constitue *l'indice de réfraction* de ce corps. Puisque les deux rayons polarisés nés dans ce cernier le traversent à des vitesses différentes, à chacune de celles-ci correspond un indice de réfraction déterminé et propre au corps considéré.

Jusqu'à présent, nous avons supposé qu'il tombe sur le cristal un seul rayon lumineux dans une incidence quelconque. En réalité, dans les conditions expérimentales, une infinité de rayons tombent sur le corps et se polarisent tout en le traversant. Pour caractériser le cristal, on retient généralement le plus rapide et le plus lent de ces multiples rayons lumineux polarisés, c'est-à-dire son plus petit (n_p) et son plus grand (n_g) indice de réfraction.

La différence de temps que mettent ces deux rayons pour traverser le cristal s'appelle *retard*. Celui-ci s'exprime ordinairement en espace: le retard est la différence des épaisseurs d'air que les vibrations lumineuses parcourraient dans le temps qu'elles mettent à traverser le cristal. On l'exprime en millimètres ou, pour la facilité de l'écriture, en millionièmes de millimètre ($\mu\mu$).

Le retard rapporté à l'unité d'épaisseur n'est autre que la différence entre les deux indices de réfraction d'un rayon traversant le cristal et s'appelle la *biréfringence* dans la direction considérée, mais on entend généralement par biréfringence du cristal, la différence des deux indices extrêmes.

La biréfringence se met en évidence à l'aide du microscope polarisant: en lumière blanche et entre nicols croisés, le cristal se pare de couleurs particulières appelées teintes de polarisation dont la tonalité dépend de la différence entre les deux indices de réfraction pour une épaisseur donnée. Pour employer une autre expression, chaque teinte de polarisation caractérise le produit de l'épaisseur du cristal par sa biréfringence, c'est-à-dire, le retard. On mesure ce dernier à l'aide d'appareils spéciaux comme le compensateur de Berek et on en déduit la biréfringence.

Celle-ci est une propriété de beaucoup de milieux: elle n'est pas spécifique de l'état cristallin proprement dit. Aussi n'a-t-elle pas toujours la même cause.

LES DIFFÉRENTS TYPES DE BIRÉFRINGENCE

(1) *Biréfringence propre* (Eigendoppelbrechung).—Le cas le plus classique est celui des milieux cristallisés: ceux-ci sont caractérisés par une disposition réticulaire des atomes. Chaque axe de direction quelconque traversant le cristal passe par des successions différentes d'atomes: cependant, le long des axes de même direction, l'alternance des atomes de diverses espèces est toujours identique pour une architecture atomique déterminée.

Si un rayon lumineux suit ces directions au travers du cristal, il vient buter successivement sur des atomes qui affectent sa vitesse: cette influence n'est pas identique pour tous les assemblages linéaires d'atomes. On comprend donc que la vitesse des rayons lumineux ne soit pas la même dans chacune des multiples directions qu'ils peuvent emprunter dans le réseau. A cause de la spécificité de la répartition atomique dans les différents réseaux cristallins, la vitesse de passage du rayon lumineux sera toujours

la même pour un corps donné dans un axe déterminé. Par conséquent, les indices de réfraction doivent être considérés comme des éléments spécifiques de la nature chimique des corps.

La biréfringence étant la différence entre les deux indices principaux d'un cristal, elle est également spécifique de l'agencement du réseau cristallin et de la nature chimique des atomes qui constituent celui-ci. C'est la biréfringence de ce type qui est la biréfringence propre d'un cristal homogène.

La biréfringence ne varie jamais en fonction de l'indice de réfraction du liquide dans lequel le cristal est plongé. Elle n'existe pas pour tous les corps cristallisés: ceux qui appartiennent au système cubique ne possèdent qu'un seul indice de réfraction. Ils sont appelés pour cette raison optiquement isotropes. Les corps biréfringents sont anisotropes.

Ajoutons enfin qu'un milieu ne présentant pas de structure réticulaire ne possède pas de biréfringence propre.

(2) *Biréfringence de forme ou de structure* (Formdoppelbrechung).—Dès 1863, Schultze a constaté que la biréfringence des carapaces de diatomées varie selon l'indice de réfraction du milieu dans lequel elles sont plongées. C'est la première observation ayant pour objet la physique optique des systèmes complexes.

Beaucoup plus tard, les travaux de Wiener (1) ont amené de grandes précisions au sujet de cette branche de l'optique et ont permis d'énoncer une propriété fondamentale des systèmes complexes: ils sont formés par des particules isotropes ou anisotropes régulièrement ordonnées et noyées dans un milieu isotrope ou anisotrope, mais d'indice de réfraction différent du premier.

Les recherches plus récentes encore d'Ambronn, de Frey, de Wissling (1) principalement, sur les propriétés optiques de ces composés (mixed bodies ou Mischkörper) ont également amené de précieuses contributions à l'étude des ces questions.

On connait deux types de biréfringence de forme:

(1) Celle que les auteurs allemands appellent Stäbchendoppelbrechung, que nous traduisons par biréfringence de bâtonnets: elle se présente quand le corps complexe est constitué de cylindres placés parallèlement les uns aux autres et inclus dans un milieu quelconque solide, liquide ou gazeux, mais d'indice de réfraction différent de celui des cylindres ou bâtonnets.

(2) Celle que les mêmes auteurs appellent Plättchendoppelbrechung ou biréfringence de plaquettes: dans ce cas, les éléments plongés dans le milieu quelconque accusent la forme de plaquettes à orientation parallèle.

Les conditions nécessaires à l'apparition de la biréfringence de forme dans les corps complexes sont:

(a) L'indice de réfraction des plaques ou des bâtonnets doit être différent de celui du milieu ambiant;

(b) l'épaisseur des plaques et le diamètre des cylindres ainsi que la distance qui les sépare doit être petite par rapport à la longueur d'onde de la lumière;

(c) pour qu'il s'agisse d'une biréfringence de forme pure, les plaques et les cylindres ne doivent pas présenter de biréfringence propre: quand cette dernière existe, elle s'ajoute à la biréfringence de forme ou s'en soustrait.

° ° °

C'est à Wiener (1) que revient le mérite d'avoir proposé une explication de la biréfringence de forme en prenant comme base la théorie électromagnétique de la lumière. En ce qui concerne le fondement mathématique, nous ne considérerons avec quelques détails que la biréfringence de bâtonnets, puisque seule elle intéresse l'étude de l'édifice moléculaire osseux.

Soit un corps constitué comme le représente schématiquement la Fig. 1. Deux éléments différents le composent: des cylindres d'une nature chimique donnée et la substance ambiante d'une autre nature.

Appelons respectivement n_1 et δ_2 l'indice de réfraction et le volume relatif des cylindres et n_2 et δ_2 ceux du corps qui remplit les intervalles compris entre les cylindres: il est bien entendu que $\delta_1+\delta_2=1$.

Un corps mixte de ce type est anisotrope et se comporte comme un corps optiquement uniaxe, l'axe optique étant parallèle à l'axe des cylindres. Appelons n_a et n_o ses deux indices de réfraction principaux. A

condition qu'il soit incolore, la théorie de Wiener donne pour le calcul de ces deux indices les expressions suivantes:

$$n_a^2 = \delta_1 n_1^2 + \delta_2 n_2^2 \qquad (1)$$

$$n_0^2 = n_2^2 \frac{(\delta_1+1)n_1^2 + \delta_2 n_2^2}{(\delta_1+1)n_2^2 + \delta_2 n_1^2}. \qquad (2)$$

La biréfringence de forme est $B_f = n_a - n_o$: la théorie démontre qu'elle est toujours positive.

Lorsque $n_1 = n_2$, c'est-à-dire lorsque les indices de réfraction des cylindres et du milieu ambiant sont identiques, la biréfringence de forme est nulle, le corps est donc complètement obscur dans toutes ses positions entre nicols croisés, à condition qu'aucun de ses deux composants ne possède de biréfringence propre.

La Fig. 2 (courbe *b*) montre comment la biréfringence de forme du corps complexe varie en fonction de l'indice de réfraction d'un des deux composants. Quand les indices de réfraction de ces derniers sont identiques, la biréfringence de forme est nulle: elle s'élève d'autant plus que les indices de réfraction des cylindres et de la substance ambiante deviennent différents.

En ce qui concerne la biréfringence de plaquettes, signalons qu'au contraire de la biréfringence de bâtonnets, elle est toujours négative, mais que les corps complexes qui la présentent sont également uniaxes.

(3) *Biréfringence de forme combinée à une biréfringence propre.*—Si une des substances constitutives du corps complexe possède une biréfringence propre, la courbe que l'on obtient en l'immergeant dans des liquides d'indices de réfraction différents est une résultante de la biréfringence de forme et de la biréfringence propre. Rappelons que cette dernière n'est nullement influencée par les variations de l'indice de réfraction du milieu ambiant. Dans le cas d'une biréfringence de bâtonnets et d'une biréfringence propre négative, on obtient la courbe *a* de la Fig. 2: l'assemblage de cylindres plongé dans un corps possédant le même indice de réfraction que ceux-ci accuse une biréfringence négative correspondant à la biréfringence propre. La courbe *c* de la même figure se rapporte à un corps possédant une biréfringence propre positive.

On peut obtenir des courbes de même allure en portant en ordonnées le retard

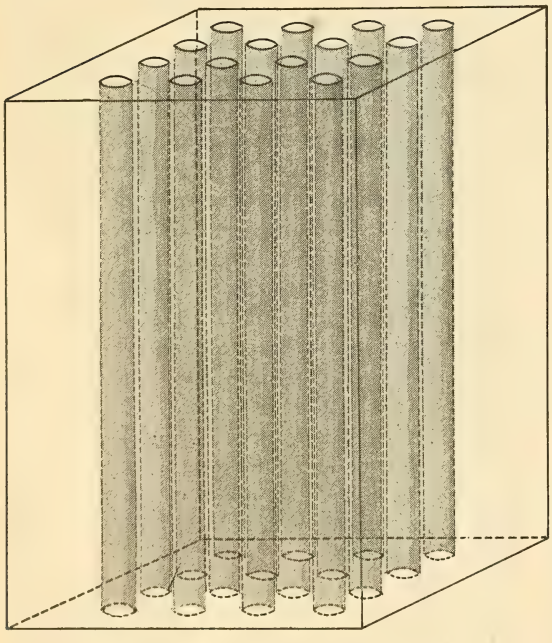


FIG. 1.—Représentation schématique d'un corps complexe formé de cylindres noyés dans une substance ambiante.

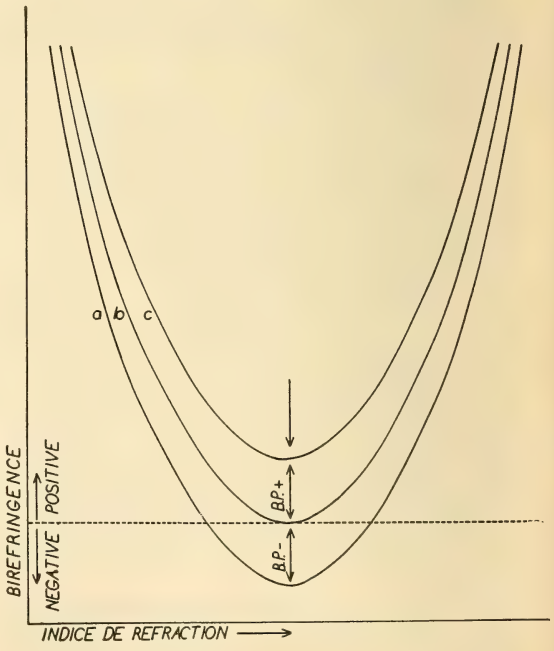


FIG. 2.—Courbes de biréfringence de forme combinée ou non à une biréfringence propre.

pour une épaisseur donnée au lieu de la biréfringence, celle-ci étant en effet directement proportionelle au retard.

(4) *Autres types de biréfringences.*—Toutes les actions physiques capables de provoquer l'orientation ordonnée des molécules dans les solides ou les liquides peuvent entraîner l'apparition d'une biréfringence: citons, par exemple, la biréfringence qui se manifeste à l'application d'une force de traction ou de pression à la gélatine, au verre, à la celloidine; d'autre part, la biréfringence de flux que l'on observe en orientant des molécules allongées dans une solution obligée à passer sous pression dans un tube capillaire.

LA BIRÉFRINGENCE DE L'OS MINÉRALISÉ

Quand on immerge une lame d'os total (par exemple, d'environ 100μ d'épaisseur) successivement dans chacun des liquides constituant l'échelle des indices de réfraction, les teintes de polarisation observées entre nicols croisés demeurent les mêmes quels que soient les caractères optiques du liquide d'immersion.[2] Lorsque nous débarrassons cette même lame de ses matières organiques, par ébullition dans la glycérine renfermant 6 per cent de potasse (os minéralisé), nous observons que l'aspect iconographique général de l'os ne s'est nullement modifié, mais cette fois, les teintes de polarisation varient avec l'indice de réfraction du liquide dans lequel la lame est immergée. Cette observation a déjà été commentée par Schmidt (14) qui l'avait attribuée à la biréfringence de forme. Cet auteur a constaté également que l'os minéralisé possède une biréfringence propre.

L'os minéralisé constitue le matériel de choix pour de telles recherches: on peut considérer, d'après les observations de Schmidt, qu'il obéit aux lois de la biréfringence de bâtonnets, ceux-ci étant représentés par les espaces abandonnés par les longues molécules organiques détruites par la potasse.

Nous avons cherché à préciser les résultats purement qualitatifs obtenus par Schmidt en nous efforçant d'obtenir des valeurs numériques que nous pourrons comparer à celles que nous avons obtenues pour l'os total. Nos recherches sont basées sur un certain nombre de données que nous avons publiées antérieurement: nous allons les rappeler succinctement.

VALEURS EXPÉRIMENTALES DÉTERMINÉES ANTÉRIEUREMENT

(1) *Biréfringence de l'os total.*—Après avoir revu la topographie générale des canaux osseux et constaté qu'elle présente un parallélisme étroit avec celle des éléments cristallins (7), nous avons pu établir les conditions indispensables dans lesquelles il faut opérer pour déterminer la biréfringence de l'os total (12). Celle-ci est faible: elle est très proche de 0.004 et elle est positive.

(2) *Les indices de réfraction de l'os total et de l'os minéralisé.*—Nous avons mesuré l'indice de réfraction de l'os total et de l'os minéralisé par trois méthodes qui se contrôlent mutuellement: procédés de la frange de Becke et de Schroeder von der Kolk en lumière monochromatique ($\lambda = 5891$ Å) et apparition des franges colorées en lumière blanche. L'indice de réfraction des liquides dans lesquels les fragments de substance sont immergés est mesuré au moyen du réfractomètre d'Abbe (6.8.10).

Nous avons obtenu les résultats suivants:

Os total: $n = 1.574$.

Os minéralisé: $n = 1.590$.

L'indice de l'os total a été déterminé sur des fragments d'os sec: l'importance de cette remarque sera discutée ultérieurement.

(3) *Poids spécifique de l'os total et de l'os minéralisé.*—Nous avons démontré que la précision de ces mesures est soumise à certaines conditions et particulièrement au remplissage parfait par le liquide d'immersion (l'eau) des canaux vasculaires et des cavités cellulaires de l'os total (10). A ces espaces s'ajoutent dans l'os minéralisé le volume laissé libre par les molécules organiques hydrolysées par la potasse. En un mot, les mesures de poids spécifique doivent se faire dans un vide aussi complet que possible de façon à ce que le liquide d'immersion puisse pénétrer librement dans tous les espaces creux de la substance. Pour

[2] A condition que ces liquides ne soient pas miscibles à l'eau, ce qui est d'ailleurs le cas pour la plupart d'entre eux: nous envisagerons en détail, dans une publication ultérieure, son attitude dans les liquides miscibles à l'eau.

pouvoir travailler sur une faible quantité de matériel pulvérisé, nous avons mis au point une méthode de micropycnométrie dans le vide que nous donne d'excellents résultats (13). Pour l'os total, nous avons déterminé un poids spécifique de 2.35 et pour l'os minéralisé de 2.99.

(4) *Indice de réfraction de la substance organique de l'os.*—Cette détermination a été faite sur du matériel décalcifié par l'acide chlorhydrique à 3 per cent dans l'eau ou dans l'alcool méthylique absolu. Après décalcification complète en un temps très court (en moyenne 24 heures), les plaquettes d'os de 50 à 100μ d'épaisseur sont lavées et séchées. Nous avons trouvé par les méthodes énumérées plus haut une valeur constante de 1.547 pour une série d'échantillons d'osséine sèche (6). Nous insistons sur ce caractère de siccité et nous reviendrons sur cette question ultérieurement.

VALEURS EXPÉRIMENTALES NOUVELLES BIRÉFRINGENCE DE L'OS MINÉRALISÉ

Méthode de travail

Préparation des lames.—Le matériel utilisé pour ce travail est le fémur de bovidé. De fines lames d'os de 4 mm$\times$4 mm environ sont sciées au niveau de l'extrémité diaphysaire: nous choissons cette zone de l'os dans le but de trouver dans nos coupes des plages orientées dans tous les sens, ce qui nous permet de choisir les régions les plus favorables à nos recherches. Ces lames, d'une épaisseur de 0.5 mm sont régularisées et amincies à la lime. Elles sont ensuite débarrassées de la graisse médullaire, qui imbibe fréquement la substance organique fondamentale, par trempage dans le chloroforme. Elles sont enfin séchées à la température ordinaire.

Nous enregistrons schématiquement par dessin au faible grossissement du microscope l'ensemble des canaux et des plages osseuses situées entre ceux-ci. Nous recherchons les zones au niveau desquelles la structure du tissu est favorable aux mesures de retard et nous en retenons de 5 à 10 présentant des caractères suffisamment nets pour permettre de les retrouver aisément. Il est, en effet, indispensable que les nombreuses mesures de retard que nos recherches exigent se fassent rigoureusement aux mêmes points de la lame. Ces plages repérées sont soigneusement dessinées au fort grossissement avec assez de détail pour permettre un repérage précis.

Mesure du retard de l'os total.—Pour les mesures de retard au niveau des zones repérées, la lame osseuse set plongée dans un liquide non miscible à l'eau, le bromoforme.

Les mesures de retard sont exécutées au moyen du compensateur de Berek.

Pour la lame que nous choisissons comme exemple particulièrement démonstratif et qui nous a permis l'expérience la plus complète, la valeur de retard obtenue au niveau des zones repérées donne une moyenne de 462$\mu\mu$.

Minéralisation de l'os total.—Après la détermination du retard, nous immergeons la lame dans de la glycérine renfermant 6 per cent de potasse et chauffée à 290°. Le blanchîment de la substance après la première période de noircissement nous indique la fin de la destruction des matières organiques.

La lame devenue très fragile est lavée abondamment dans l'eau distillée chaude jusqu'à neutralité du liquide de lavage, puis elle est séchée à l'étuve à 105°C. Le séchage à cette température n'influence nullement les propriétés optiques des lames minéralisées: nous savons qu'il modifie au contraire la biréfringence des lames d'os total.

Détermination de la courbe des retards en fonction de l'indice de réfraction des liquides d'immersion

La lame est plongée successivement dans chacun des liquides hydrophiles ou lipophiles dont la nature et l'indice de réfraction sont indiqués au tableau I et elle y est maintenue un nombre d'heures ou de jours suffisants pour que la retard accusé par les zones osseuses repérées devienne constant. Nous avons observé, en effet, que si certains produits donnent à la lame une valeur de retard définitive dès l'immersion, d'autres tels que la trioléine, la tributyrine, l'essence de térébenthine, le benzoate de benzyle, le cinnamate d'éthyle et le valérianate d'amyle ne nous mermettent pas d'enregistrer d'emblée une valeur de retard constante. Ce sont les premiers qui nous ont permis de tracer la courbe de biré-

fringence de forme et d'interpréter les valeurs obtenues avec les liquides entraînant des variations progressives du retard. Lorsqu'après son immersion dans certains de ceux-ci (le valérianate d'amyle, par exemple), la lame est optiquement positive, nous observons d'emblée une valeur de retard nettement inférieure à celle que nous pouvions prévoir d'après les résultats obtenus au moyen des liquides ne provoquant pas de variation. Au contraire, quand la lame est plongée dans un liquide lui donnant un caractère optiquement négatif, le retard est normal dès l'immersion, mais il augmente de valeur dans le sens de la négativité au cours des jours suivants jusqu'à une valeur constante qu'il ne dépasse plus. Cette modification du retard dans un sens ou dans l'autre est plus ou moins rapide selon les liquides. C'est avec la trioléine que nous avons observé les variations les plus marquées et en même temps les plus lentes. Dans un cas, 8 jours ont été nécessaires pour que le retard d'une plage d'os minéralisé passe de $+31$ à $-203\mu\mu$; dans un autre cas, la valeur constante ne s'est établie qu'après 15 jours. Le sens et l'importance des variations observées sont indiqués à la figure 3 qui rassemble nos observations relatives à une de nos lames osseuses. Nous n'avons pas encore pu établir expérimentalement la cause de ces variations de retard: nous notons cependant que les liquides pour lesquels on les observe sont généralement formés de molécules à chaînes de carbone longues ou compliquées, tandis que les autres produits accusent des formules de structure plus courtes et plus simples: ces molécules pourraient faire intervenir un élément optique supplémentaire par suite de leur orientation dans les espaces abandonnés par la substance organique de l'os. Cette orientation se ferait plus ou moins rapidement selon la viscosité du liquide.

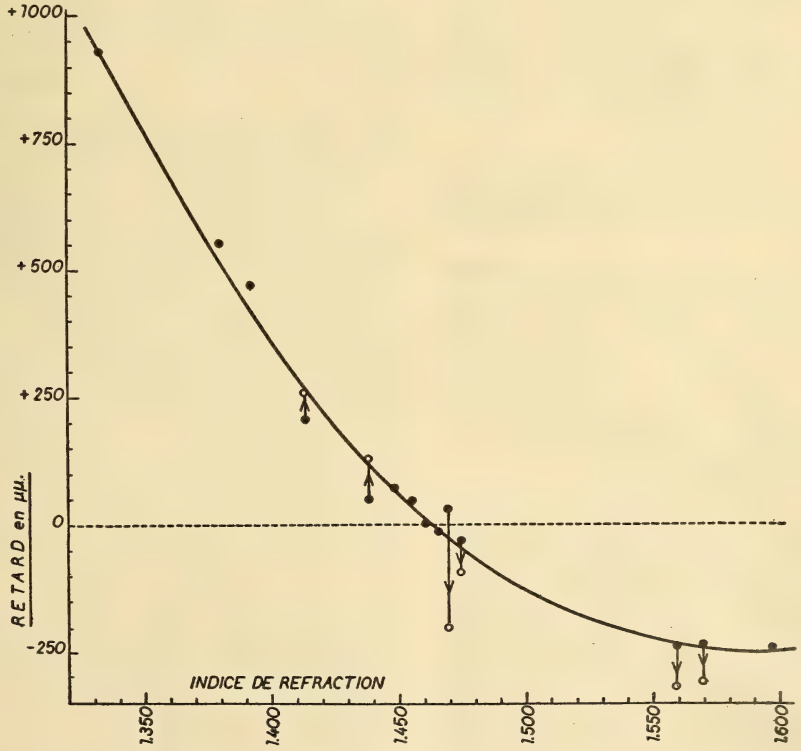


FIG. 3.—Variations du retard d'une lame d'os minéralisé en fonction de l'indice de réfraction des liquides dans lesquels elle est plongée. Les points représentent la valeur initiale du retard; les cercles, la valeur finale si celle-ci est différente de la première. Les flèches indiquent le sens de la variation.

Nous insistons sur le fait que l'explication que nous proposons aux phénomènes observés relève uniquement du domaine de l'hypothèse.

Interprétation de la courbe des retards

A la Fig. 3, nous notons en ordonnées les moyennes des retards observés au niveau des zones étudiées d'une lame minéralisée et en abcisses les indices de réfraction des liquides dans lesquels cette lame a été immergée.

La courbe est tout à fait comparable à celle représentée à la figure 2 (courbe *a*). Nous avons pu poursuivre la recherche jusqu'à l'obtention du retard négatif maximum: ces expériences sont le plus souvent interrompues par destruction accidentelle des lames minéralisées.

Nous avons déterminé au cours de recherches antérieures (6.8.10) l'indice de réfraction de l'os minéralisé: il est de 1.590. Or, c'est précisément pour une valeur très voisine de celle-ci que le retard négatif maximum de notre lame apparaît. Cette première coïncidence montre déjà que nos observations s'accordent avec la théorie de la biréfringence de forme.

L'étude de cette courbe nous permet de tirer une série de renseignements précis au sujet des propriétés optiqués des lames d'os minéralisé.

Biréfringence propre de la substance minérale osseuse.—Le retard négatif maximum de la lame étudiée est $-250\mu\mu$. D'autre part, le retard mesuré au niveau des mêmes zones de la plaque avant la minéralisation était de $+462\mu\mu$. Ajoutons enfin que la biréfringence de l'os total est 0.004, ainsi que nous l'avons déjà rappelé.

A l'aide de ces trois données numériques, nous pouvons calculer la biréfringence propre de la substance minérale osseuse.

Il semble a priori très simple et exclusivement nécessaire pour déterminer cette dernière d'appliquer la formule $B=R/E$, R étant le retard et E l'épaisseur. En réalité, quand on s'adresse à un corps de structure aussi compliquée que l'os, de telles déductions sont impossibles: elles ne sont permises au sujet de l'os que dans des cas particuliers que nous avons étudiés en détail dans une publication antérieure (12). En dehors de ceux-ci, nous sommes forçés d'utiliser un procédé indirect qui seul peut nous donner des résultats de valeur indiscutable. Voici la base de notre raisonnement.

D'une part, l'axe optique de l'os total a la même orientation que celui de l'os minéralisié. D'autre part, rappelons-le, l'architecture minérale cristalline de l'os total ne subit aucune variation au cours de la minéralisation ainsi que le montre l'examen microscopique d'une lame d'os total et de la même lame minéralisée.

Par conséquent, connaissant le retard (R_t) au niveau d'une zone topographiquement précisée d'une lame d'os total et le retard (R_m) au niveau de cette même zone après la minéralisation de la lame, nous sommes en droit d'écrire que les deux retards mésurés sont dans les mêmes rapports que les biréfringences correspondantes (B_t et B_m). Cela peut s'exprimer par la relation

$$\frac{R_t}{R_m}=\frac{B_t}{B_m} \text{ ou } \frac{+462}{-250}=\frac{+0.004}{B_m},$$

d'où $B_m=-0.0022$

qui constitute la biréfringence propre négative de l'os minéralisé.

Notons cependant qu'en toute rigueur cette proportion n'est pas exacte: elle n'est admissible que lorsque les biréfringences sont faibles, comme c'est le cas pour le matériel que nous étudions. L'exemple suivant montre que nous sommes en droit de l'utiliser: considérons deux cristaux uniaxes ayant, le premier, une biréfringence positive de 0.004 et un indice ordinaire $n=1.48$, le deuxième, une biréfringence négative de 0.002 et un indice ordinaire $n=1.59$ et taillons-en des lames orientées à 45° de l'axe optique. Le calcul montre que les biréfringences de ces lames sont respectivement 0.001996 et 0.001001. Leur rapport est donc 1.994. On voit qu'il est pratiquement le même que le rapport des biréfringences de ces cristaux (2.000), la différence ne portant que sur la troisième décimale. Notons de plus que nous avons choisi, pour cet exemple, des lames taillées à 45°, ce qui constitue le cas ou l'erreur est la plus forte. Nous pouvons donc considérer que le rapport utilisé est vrai à

moins de 0.3 per cent près. Il n'en serait plus de même si les biréfringences à comparer étaient élevées, au-dessus de 0.020, par exemple.

Biréfringence de forme de l'os minéralisé.— En établissants des proportions du même type que celles utilisées pour le calcul de la biréfringence propre, nous avons pu dresser la liste des biréfringences de forme, pour les différents milieux d'immersion (tableau 1).

L'ensemble de ces résultats nous permet de tracer les trois courbes représentées à la Fig. 4: courbe de biréfringence de forme, de biréfringence totale et de biréfringence propre de l'os minéralisé. Nous avons représenté par des points noirs les valeurs déterminées expérimentalement figurant déjà au graphique 3, mais en regard d'une ordonnée graduée en retard. Nous avons inscrit également (cercles) les valeurs théoriques déduites des formules de Wiener pour la biréfringence de forme. Nous pouvons constater que la courbe tracée le long des points expérimentaux passe également par les points théoriques. Nous pouvons en déduire que la fraction minérale de l'os est bien soumise aux lois de physique optique que Wiener a établies pour les corps complexes dont un des constituants présente la forme de bâtonnets.

D'après sa nature même, la biréfringence de forme ne peut s'exprimer par un nombre comme la biréfringence propre: elle est, en effet, différente selon l'indice de réfraction du liquide dans lequel la lame d'os minéralisé est plongée. Dans le cas qui nous occupe, elle s'exprime graphiquement par une courbe du type parabolique et, mathématiquement, par une équation du 2ème degré telle que celle-ci, $B_f = 0.156\ (n_1 - n_2)^2$ qui répond avec une précision suffisante aux différents points établis expérimentalement.

Indice de réfraction de la substance organique de l'os.—Nous avons déterminé par les méthodes habituelles l'indice de réfraction de lames d'os taillées à une épaisseur assez réduite pour pouvoir être décalcifiées en quelques heures par l'acide chlorhydrique à 3 per cent dans l'eau ou dans le méthanol. L'avantage que nous voyons au séjour très limité dans les liquides décalcifiants est d'éviter l'altération chimique de la substance organique fondamentale. Après cette opération, les lames sont abondamment lavées à l'eau ou au méthanol, puis séchées à l'étuve à 105° pendant 2 heures. L'indice de réfraction que nous avons

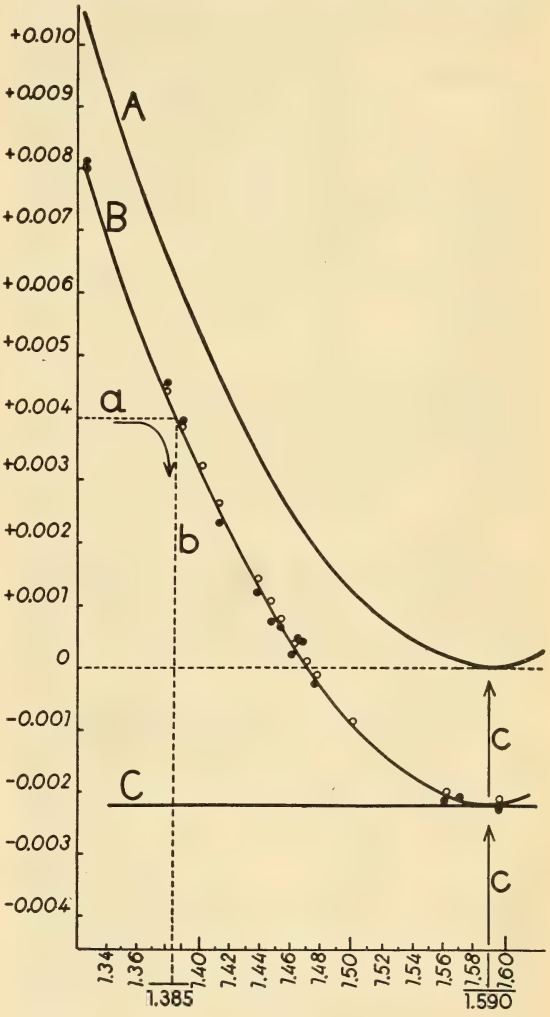


FIG. 4.—En ordonnées: la biréfringence.
En abcisses : l'indice de réfraction.
A, Courbe de biréfringence de forme calculée à partir de la courbe de biréfringence totale. B, Courbe de biréfringence totale avec points théoriques (cercles) et points déterminés expérimentalement (points noirs). C, Courbe de biréfringence propre: *a*, Projection de la biréfringence de l'os total (déterminée expérimentalement) sur la courbe de biréfringence totale; *b*, projection du point correspondant de cette courbe sur l'axe des abcisses = indice de réfraction de la substance organique fondamentale; *c*, indice de réfraction de la substance minérale de l'os; la valeur ainsi déterminée est égale à celle qu'on obtient par mesure directe.

mesuré (6) sur le matériel ainsi préparé est 1.547.

TABLEAU 1.—VALEURS MOYENNES DES BIRÉFRINGENCES TOTALES ET DES BIRÉFRINGENCES DE FORMES CALCULÉES À PARTIR DES RETARDS MESURÉS AU NIVEAU DE RÉGIONS REPÉRÉES D'UNE LAME D'OS MINÉRALISÉ PLONGÉE DANS DIFFÉRENTS LIQUIDES.

Liquide	Indice de réfraction	Retard en $\mu\mu$		Biréfringence	
		Initial	Constant	Totale	de forme
Eau	1.333	+931	+931	+8.1	+10.3
Acétal diéthylique	1.380	+555	+555	+4.8	+ 7.0
Alcool butylique n.	1.392	+472	+472	+4.1	+ 6.3
Valérianate d'amyle	1.413	*+209*	+263	+2.2	+ 4.4
Tributyrine	1.438	+ *50*	+131	+1.0	+ 3.2
Tricapryline	1.448	+ 61	+ 61	+0.5	+ 2.7
Cyclopentanol	1.455	+ 47	+ 47	+0.4	+ 2.6
Tétrachlorure de carbone	1.460	− 04	− 04	0	+ 2.2
Acétate de bornyle	1.465	− 30	+ 01	−0.3	+ 1.9
Trioléine	1.469	+ 31	*−203*	+0.3	+ 2.5
Essence de térébenthine	1.474	− 31	*− 93*	−0.3	+ 1.9
Cinnamate d'éthyle	1.559	−239	*−320*	−2.1	+ 0.1
Benzoate de benzyle	1.569	−238	*−311*	−2.1	+ 0.1
Bromoforme	1.596	−253	−253	−2.2	0

D'autre part, cet indice de réfraction peut être déterminé par une méthode indirecte basée sur les résultats de notre étude de la biréfringence de forme de l'os minéralisé.

Comme nous le savons, la biréfringence de l'os total est une biréfringence de forme: par conséquent, la substance organique fondamentale dans laquelle les éléments cristallins minéraux sont noyés peut être considérée comme un des liquides dans lesquels les lames d'os minéralisé ont été plongées au cours de notre détermination de la courbe de biréfringence totale (résultant de la combinaison de la biréfringence propre avec la biréfringence de forme) plus précisément encore, la substance organique fondamentale correspond au liquide dans lequel l'os minéralisé accuse une biréfringence égale à celle de l'os total, c'est-à-dire 0.004 (12). Par conséquent, en reportant sur cette courbe (Fig. 4B) la valeur de la biréfringence de l'os total, l'axe que nous abaissons sur l'abcisse passe par l'indice de réfraction de la substance organique fondamentale. Cette interpolation est indiquée graphiquement à la même figure. Elle nous indique que la substance organique fondamentale accuse un indice de réfraction de 1.385, valeur bien différente de celle que nous avions mesurée expérimentalement sur le matériel sec.

Une telle contradiction entre nos résultats trouve une explication très simple.

L'os vivant, tissu doué d'un réseau circulatoire abondant dont nous avons rappelé l'organisation (7) est imbibé des liquides plasmatiques. Les molécules d'eau qui constituent la majeure partie de ceux-ci sont glissées comme les microcristaux de la fraction minérale de l'os entre les molécules allongées de la substance organique fondamentale qu'elles imprègnent. Cette substance organique fondamentale, que nous recueillons après la décalcification de l'os, est formée d'un ensemble de molécules orientées qui semblent s'apparenter à la gélatine, sinon s'identifier avec celle-ci. Quoiqu'il en soit, si chimiquement leurs propriétés d'imbibition sont très proches, il existe entre la gélatine et l'osséine une différence importante que révèlent les études optiques: pour s'orienter et manifester une biréfringence, les molécules de gélatine doivent subir une traction ou une pression (1), tandis que les molécules de la substance organique fondamentale de l'os sont naturellement orientées à l'état de repos. Toutefois, cette orientation n'est absolument parfaite et ne devient totalement superposable à celle de l'os total que pour un degré d'imbibition d'eau déterminé, voisin de la saturation. C'est donc à l'état de saturation d'eau que nous devons étudier les propriétés physiques de la substance organique fondamentale. Partant de cette idée, nous avons mesuré l'indice de réfraction de l'os décalcifié après l'avoir laissé séjourner 24 heures dans l'eau distillée ($n = 1.333$). Nous avons pu déterminer le chiffre de 1.380, valeur s'accordant parfaitement avec celle que l'étude de la biréfringence de forme de l'os minéralisé nous a fournie. Notons bien d'ailleurs que l'indice de réfraction de l'eau est proche de celui des liquides plasmatiques (plasma, $n = 1.3540$; sérum, $n = 1.3481$).

On peut donc admettre qu'à l'état sec, l'os décalcifié a un indice de réfraction de 1.547, mais que, dans les conditions d'imbibition optima, cette valeur passe à 1.380.

Notons d'ailleurs qu'elle varie entre ces deux extrêmes avec le degré de l'imbibition.

Ajoutons encore que nous avons pu extraire de l'os une substance durcissant à la dessication, jaune et transparente. Nous l'obtenons en quelques heures de l'os total dégraissé et finement pulvérisé, en le traitant par de l'eau distillée dans un appareil de Soxhlet. L'eau d'extraction ne dépasse pas la température de 60°C. La substance obtenue par ce procédé, beaucoup moins brutal que les méthodes habituelles de préparation de la gélatine, ne montre aucune biréfringence et ne diffracte pas les rayons X: ses molécules constitutives ne sont donc pas régulièrement orientées; elle accuse à l'état sec un indice de réfraction, 1.544, très voisin de celui de l'os décalcifié sec. Comme nous l'avons déjà observé pour ce dernier, l'hydratation abaisse considérablement cet indice.

VOLUMES RELATIFS ET POIDS SPÉCIFIQUES DE LA FRACTION MINÉRALE ET DE LA FRACTION ORGANIQUE DE L'OS TOTAL

L'étude de la courbe de biréfringence de forme nous a fourni des renseignements nouveaux indispensables pour l'application à l'os de la théorie de Wiener. Toutefois, d'autres données numériques nous manquent encore et tout particulièrement le volume des constituants organiques et des constituants minéraux de 100 gr. d'os. Nous les appelons respectivement Δ_1 et Δ_2; pour les calculer nous nous basons sur les valeurs expérimentales suivantes:

(1) Poids spécifique de l'os frais hydraté. Il a été mesuré par la macrométhode pycnométrique classique sur des fragments de fémur frais: ceux-ci ont été immergés dans l'eau dès qu'ils furent recueillis chez l'animal de façon à ce que l'air n'aît pu pénétrer dans les canalicules osseux et fausser nos résultats. Nous avons obtenu $D_t = 2.00$.

(2) Poids spécifique de la fraction minérale de l'os, $D_2 = 2.99$ (*10*).

(3) Teneur de l'os frais en matières minérales.

L'os frais normalement hydraté est pesé, puis séché, pulvérisé et bouilli dans la glycérine renferment 6 per cent de potasse: il est de nouveau pesé. Nous retrouvons 67.7 per cent du poids primitif: c'est la valeur P_2.

(4) Teneur de l'os frais en eau d'imbibition: l'os frais est pesé, séché à l'étuve à 105° et pesé à nouveau: la perte pondérale est 13.8 per cent.

(5) Teneur de l'os frais en matières organiques: l'os frais est pesé, puis décalcifié par l'acide chlorhydrique à 3 per cent dans le méthanol pur. Il est ensuite séché et pesé. Nous retrouvons 18.5 per cent du poids primitif.

L'eau d'imbibition étant exclusivement liée à l'osséine, nous devons considérer comme fraction organique de l'os frais l'ensemble des molécules détruites par KOH et des molécules d'eau, soit $P_2 = 32.3$ per cent.

Nous utilisons ces données numériques de la façon suivante: Le poids des matières minérales de l'os est égal au produit de leur poids spécifique par leur volume, $P_2 = D_2 \times \Delta_2$: nous pouvons extraire Δ_2 qui vaut P_2/D_2 (*4*). Donc $\Delta_2 = 23.30$ cc.

Comme cent grammes d'os frais occupent exactement un volume de 50 centimètres cubes, $\Delta_1 = 50.00 - 23.30 = 26.70$ cc. Un centimètre cube de ce matériel renferme donc, selon la terminologie de Wiener, δ_1 et δ_2 représentant les volumes relatifs des constituants organiques et minéraux de l'os:

$$\delta_2 = \frac{23.30}{50.00} = 0.466 \text{ cc de matière minérale}$$

$$\delta_1 = 1 - 0.466$$

$$= 0.534 \text{ cc de matière organique hydratée.}$$

Le poids spécifique de l'os décalcifié nous est donné par l'expression

$$D_1 = \frac{P_1}{\Delta_1}, \quad \text{soit} \quad \frac{32.30}{26.70} = 1.21.$$

Nous avons cherché à contrôler ce résultat par la méthode pycnométrique directe et nous avons obtenu une concordance parfaite. Ces mesures ont été exécutées sur des lames d'os décalcifié.

Il est encore possible de décomposer la valeur δ_1 et de déterminer la part qui revient aux molécules organiques et à leur eau d'imbibition: nous obtenons pour les premières

0.258 cc. pour 1 cc. d'os total hydraté et pour l'eau 0.276 cc.

En résumé, l'os contient en volume pour 100:

matières minérales.....	46.6
matières organiques.....	25.8
eau d'imbibition.....	27.6

Ces données nous serviront de base pour l'application de la théorie de Wiener à l'os et pour d'autres recherches qui feront l'objet d'une publication se rapportant aux propriétés optiques de la fraction organique de l'os.

APPLICATION DE LA THÉORIEE DE WIENER AU CAS PARTICULIER DE L'OS

Les données numériques que nous avons pu déterminer directement ou que nous avons obtenues par calcul, nécessaires à l'utilisation des formules (*1*) et (*2*) dé Wiener (page 184) sont les suivantes:

(1) l'indice de réfraction de l'os minéralisé, soit $n_2 = 1.590$,
(2) l'indice de réfraction de l'osséine, soit $n_1 = 1.385$,
(3) le volume relatif des constituants minéraux, $\delta_2 = 0.466$,
(4) le volume relatif des constituants organiques, $\delta_1 = 0.534$.

Au cours de recherches antérieures, nous avons mesuré directement la biréfringence de l'os total hydraté ainsi que l'indice de réfraction de l'os sec. D'autre part, l'indice de réfraction et la biréfringence de forme de l'os total hydraté vont nous être fournis par l'application des formules de Wiener: de la confrontation des résultats directs et indirects, nous pourrons tirer des conclusions importantes.

Remplaçons les signes employés par Wiener dans ses formules par les valeurs numériques correspondantes: formule (*1*): $n_a^2 = 0.534 \times (1.385)^2 + 0.466 \quad (1.590)^2 = 2.2024$, d'ou noùs calculons $n_a = 1.4841$, soit le plus grand indice de l'os frais que l'on puisse mesurer; formule (*2*):

$$n_0^2 = (1.590)^2 \times \frac{1.534 \times (1.385)^2 + 0.466 \times (1.590)^2}{1.534 \times (1.590)^2 + 0.466 \times (1.385)^2} = 2.1830,$$

d'où nous tirons $n_0 = 1.4775$, soit le plus petit des indices du même matériel.

Biréfringence de l'os total frais.—De ces valeurs, nous obtenons pour la biréfringence de forme de l'os, $n_a - n_0 = 0.0066$. Or, nous savons que la biréfringence totale de l'os est la résultante d'une biréfringence de forme positive dépendant aussi bien des proportions de la fraction organique que de celles de la fraction minérale, et d'une biréfringence propre négative, appartenant exclusivement à la fraction minérale $B_t = B_f - B_p$: nous avons déterminé expérimentalement cette résultante et la biréfringence propre, et nous avons trouvé $B_t = 0.004$ et $B_p = 0.0022$. On en déduit $B_f = 0.0062$, valeur très proche de 0.0066 fournie par l'application de la formule de Wiener.

En utilisant deux méthodes dont les points de départ sont très différents, l'une s'appuyant en effet sur la mesure des indices de réfraction et la composition chimique, l'autre sur des mesures de retard, nous obtenons des chiffres tout à fait comparables: nous pouvons donc attribuer à nos résultats relatifs à la biréfringence un caractère de valeurs exactes.

Indices de réfraction de l'os total.—La valeur des indices de réfraction de l'os total que nous obtenons par calculs au moyen des formules de Wiener ($n_a = 1.4775$ et $n_0 = 1.4841$) est très différente de celle que nous avons mesurée directement sur l'os sec ($n = 1.574$).

Pour essayer d'expliquer cette discordance, nous nous sommes basés sur les enseignements fournis par notre étude de l'indice de réfraction de l'os décalcifié: en effet, ce matériel à l'état de siccité accuse un indice de réfraction de 1.547, mais à l'état d'hydratation de l'osséine, ce chiffre s'abaisse à 1.385, valeur contrôlée d'ailleurs au cours de l'interprétation de la courbe de biréfringence de forme.

Nous avons donc repris des mesures d'indice de réfraction de l'os total, mais cette fois, nous nous sommes adressés à l'os frais normalement hydraté par les liquides plasmatiques: nous comptions, en effet, que les 13.8 per cent d'eau inclus dans la fraction organique de l'os total pouvaient influencer l'indice de réfraction de celui-ci. Nous avons vu que l'indice de réfraction on de l'os décalcifié s'abaisse de

0.162 sous l'influence de l'absorption des 45.2 per cent d'eau dont l'osséine est capable de s'imbiber. Ainsi, il était à prévoir que l'indice de réfraction de l'os total frais serait inférieur à celui de l'os total sec.

C'est précisément ce que nous avons pu observer par la détermination directe de l'indice de réfraction de l'os frais: ces mesures ont dû être exécutées avec des précautions particulières, car elles sont rendues extrêmement difficiles par la nature même et les propriétés de la fraction organique de l'os. Pour obtenir des valeurs exactes, nous ne pouvons utiliser que des milieux d'immersion d'hydrophobie maxima dans l'échelle de Hoffmeister. Nous reviendrons ultérieurement sur ces questions quand nous traiterons particulièrement des propriétés physiques de l'osséine. Qu'il nous suffise de signaler ici que nous avons obtenu par mesures directes une valeur $n = 1.481$ qui est exactement située entre les deux indices n_a et n_0 déterminés d'autre part au moyen des formules de Wiener.

Ici, encore une fois, nous arrivons à accorder parfaitement les résultats des mesures directes de l'indice de réfraction avec ceux que l'on obtient à partir de la courbe de biréfringence de forme en prenant la précaution de déterminer et d'utiliser les conditions indispensables à des recherches précises.

Soulignons particulièrement le fait que les recherches optiques exécutées sur l'os ne suivent exactement les lois physiques théoriques que si le matériel utilisé appartient au squelette tel qu'il existe dans l'organisme, hydraté, irrigué, vivant, comme si l'eau d'imbibition en représentait un élément fondamental au même titre que les microcristallites minéraux et les molécules d'osséine.

DISCUSSION RELATIVE À LA COMBINAISON CHIMIQUE ENTRE L'OSSÉINE ET LES SELS OSSEUX

Nous rassemblons en Tableau 2 récapitulatif les valeurs que nous avons déterminées expérimentalement et celles que nous avons obtenues par calcul à partir des courbes de biréfringence de forme établies pour une série de lames osseuses minéralisées. La comparaison entre ces deux groupes de chiffres montre qu'ils sont très proches les uns des autres, sinon identiques.

Cette similitude des résultats enregistrés par les deux méthodes nous permet des remarques importantes:

(1) Les valeurs expérimentales sont obtenues par des études successives ayant pour objet l'os total, l'os minéralisé et l'os décalcifié pris individuellement. Par contre, les valeurs calculées découlent exclusivement de la courbe de biréfringence de forme établie pour l'os minéralisé.

(2) La théorie mathématique de la biréfringence de forme est basée sur le principe initial d'une juxtaposition purement physique entre les deux constituants du corps complexe, les cylindres et la substance ambiante.

TABLEAU 2.—TABLEAU RÉCAPITULATIF DES VALEURS DÉTERMINÉES

	Déterminations expérimentales	Valeurs calculées
Indice de réfraction de l'os total sec.	1.574	—
Indice de réfraction de l'os total frais.	1.481	$n_a = 1.4841$ $n_o = 1.4775$
Indice de réfraction de l'os minéralisé	1.590	1.590
Indice de réfraction de l'os décalcifié sec	1.547	—
Indice de réfraction de l'os décalcifié saturé d'eau	1.380	1.385
Biréfringence de forme de l'os frais	+0.0062	+0.0066
Biréfringence totale de l'os frais	+0.0040	—
Biréfringence propre de la fraction minérale de l'os	−0.0022	—
Poids spécifique de l'os total sec	2.35	—
Poids spécifique de l'os total frais	2.00	1.98
Poids spécifique de l'os minéralisé	2.99	—
Poids spécifique de l'os décalcifié saturé d'eau	—	1.21
Volumes relatifs: os total	100.0 ±	
fraction minérale	46.6%	
fraction organique	53.4%	
fraction organique sèche	25.8%	
eau d'imbition	27.6%	

C'est donc en admettant a priori l'absence de tout lien chimique entre la fraction minérale et la fraction organique de l'os que nous parvenons, en prenant comme bases exclusives les caractères physiques de la substance minérale de l'os, à remonter aux propriétés et constantes optiques de l'os total et à vérifier nos valeurs expérimentales; d'autre part, nous arrivons à

établir certaines propriétés physiques de la substance organique de l'os, contrôlées également par des méthodes directes.

Une des conclusions à tirer de nos recherches est donc qu'il n'existe pas de liaison chimique primaire décelable entre la fraction minérale de l'os et l'osséine. Nous faisons donc opposition aux conclusions d'Antoniani et Usuelli (2). A notre avis, le fait que la mise en solution de l'os obéit aux lois de la chimie colloïdale n'implique pas nécessairement l'existence d'une combinaison entre l'osséine et le phosphate: il pourrait dépendre simplement de ce que la décalcification de l'os total se passe dans un milieu soumis à ces lois. Enfin, la régularité d'intrication des deux réseaux, organique et minéral, observée par Caglioti (3), ne constitute pas non plus un argument décisif en faveur d'une éventuelle combinaison entre eux; elle n'est que le témoignage de relations physiques particulièrement précises.

En ce qui concerne la liaison entre le phosphate tricalcique et des éléments appartenant à la chimie organique, nous devons répondre à une objection que l'on pourrait tirer de nos travaux antérieurs (6).

Nous avons, en effet, sur la base de certaines données expérimentales, posé l'hypothèse que le phosphate tricalcique ne se trouve pas sous la même forme dans l'os minéralisé que dans l'os total: le premier est du phosphate tricalcique α: il renferme donc deux molécules d'eau pour neuf atomes de calcium. Dans l'os total, la place de cette eau serait tenue par un petit radical organique ne possédant aucun des caractères de l'osséine et subissant l'hydrolyse sous l'action de la potasse à 290°.

Nous n'avons nullement tenu compte de cette hypothèse au cours de ce travail parce que nous n'en avions pas la possibilité technique. Si elle est fondée, nos résultats actuels laissent prévoir que les caractères physiques du phosphate tel qu'il se trouve dans l'os total et ceux du phosphate tricalcique α de l'os minéralisé sont très proches. Ce fait n'est d'ailleurs pas étonnant si, comme nous le supposons, il s'agit d'une molécule organique très simple.

CONCLUSIONS

(1) La biréfringence de l'os total résulte de la combinaison d'une biréfringence propre négative des cristallites minéraux et d'une biréfringence de forme positive du type biréfringence de bâtonnets dépendant autant des propriétés de la fraction organique que de celles de la fraction minérale de l'os.

(2) Ces combinaisons de biréfringence sont soumises aux lois purement physiques de l'optique cristalline: la fraction organique de l'os, représentée par l'osséine, n'accuse donc aucun lien chimique perceptible aux méthodes physiques avec le phosphate tricalcique, élément principal de la fraction minérale.

(4) L'os ne répond, avec fidélité aux lois physiques régissant ses propriétés optiques que lorsqu'il est physiologiquement hydraté.

(4) La présence de l'eau dans l'os frais ne semble pas relever exclusivement d'une simple imbibition: les molécules d'eau jouent un rôle structural submicroscopique.

(5) La décalcification rapide par l'acide chlorhydrique ne modifie pas les propriéts optiques de la fraction organique de l'os: l'osséine par sa séparation d'avec les sels osseux ne subit donc pas d'altération chimique perceptible à l'étude physique.

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ZOOLOGY.—*A study of the type collections of some pseudoscorpions originally described by Nathan Banks.*[1]

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(Communicated by EDWARD A. CHAPIN.)

Through the kindness of Dr. Waldo L. Schmitt and Dr. Edward A. Chapin, of the United States National Museum, type specimens of several species of pseudoscorpions originally described by Nathan Banks (1895, 1901) were made available for study. The present paper is concerned with redescriptions of Banks's *Garypus floridensis*, *"Garypus" bicornis*, *"Chelanops" arizonensis*, *"Chelifer" mirabilis*, and *"Chelifer" hubbardi*. Unless otherwise indicated, observations and measurements have been made on specimens cleared in beechwood creosote and mounted in Canada balsam. Previous to mounting, the body, but not the appendages, was treated with potassium hydroxide solution. Measurements were made with a calibrated ocular micrometer, and the figures were outlined with the aid of a camera lucida.

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Suborder DIPLOSPHYRONIDA Chamberlin, 1929

Family GARYPIDAE Hansen, 1894

Garypus floridensis Banks, 1895

Figs. 1–3

Garypus floridensis Banks, 1895, Journ. New York Ent. Soc. **3**: 9; *non* With, 1906, Danske Vid. Selsk. Skrifter, 7. Række, naturvidensk. og mathem., **3**: 41, fig. 9, pl. 2, figs. 4a–d; *non* With, 1907, Journ. Linn. Soc. London, Zool., **30**: 70–72, pl. 9, figs. 26–28; Chamberlin, 1921, Can. Ent. **53**: 191; Chamberlin, 1930, Ann. Mag. Nat. Hist. (ser. 10) **5**: 612; *pro parte* Beier, 1932, Das Tierreich **57**: 220; Roewer, 1937, *in* Bronn's Klass. und Ord. des Tierreichs **5** (div. 4, book 6): 268.

The National Museum collection of cotypes consists of one male, one female, and one early nymph. The male was mounted on a slide and designated as the lectotype. The female and the nymph are stored in alcohol. The nymph was not studied.

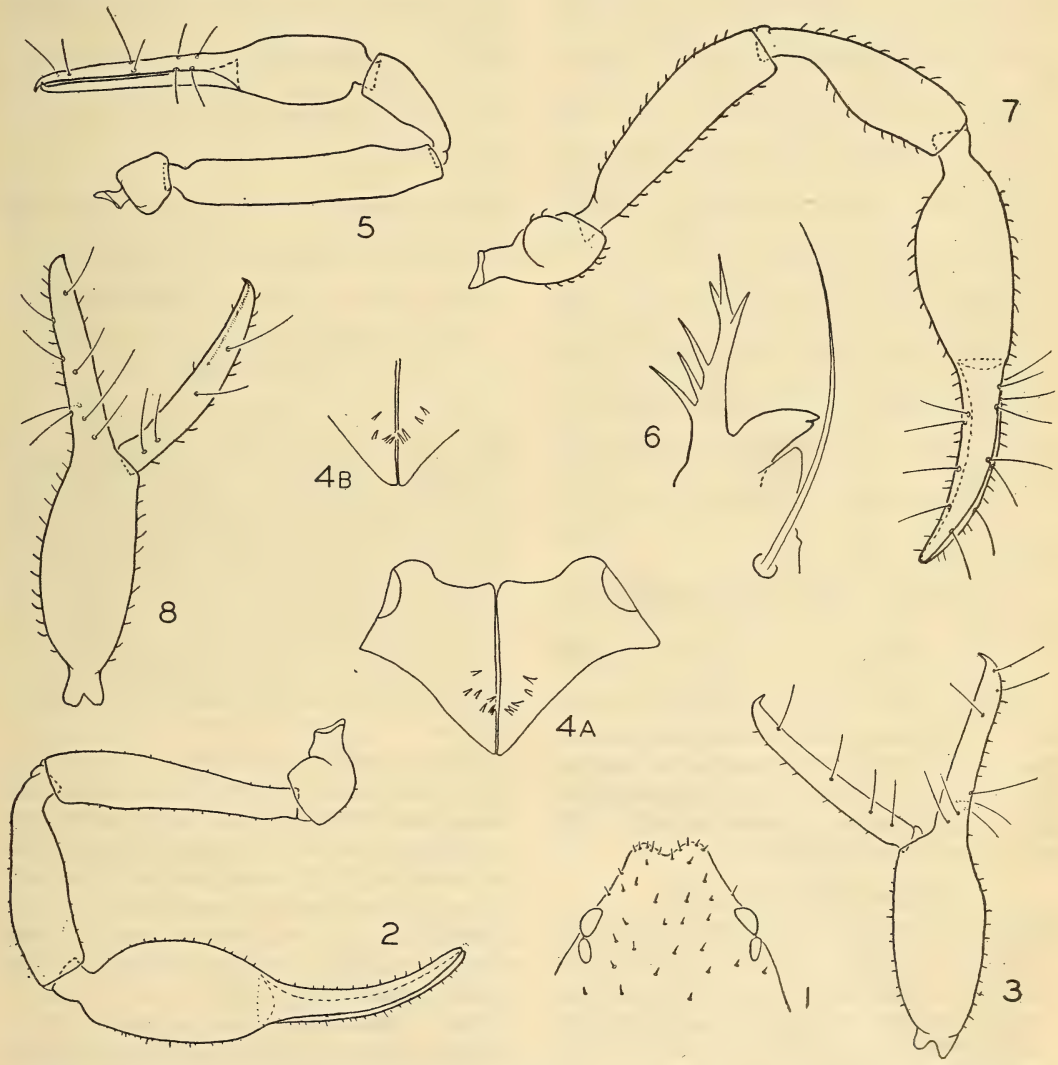
Male.—Body fairly stout, appendages moderately slender; "body pale brown, legs and palpi, except claw, pale brownish yellow, claw red-brown" (Banks, 1895); length of body 4.6

mm. Carapace subtriangular in outline, the width very little less than the length, the anterior margin bilobed; carapace weakly granular before the eyes, otherwise nearly smooth; posterior carapacal margin with 14 setae, all stublike and very short; posterior transverse furrow fairly well marked; two pairs of eyes, the anterior eye of each side with well-developed convex lens, directed laterally and anteriorly; posterior eye of each side with more weakly developed lens, directed laterally and posteriorly; eyes nearly contiguous; length of carapace 1.27 mm; width greatest posteriorly and equal to 1.25 mm; width across carapace at a level between the eyes 0.7 mm. "Abdomen depressed, much broader behind than in front, broadest on 7th segment, scutæ [sic!] short and quite broadly divided" (Banks, 1895); tergal scuta in part irregularly marked by scalelike sculpturing, anterior two tergites with fine granules on the anterior part of each, partly smooth, little sclerotic; all tergites except 1 and 11 divided; tergal halves with no more than 14 short and stubby setae. Sternites much like the tergites except the setae are a little less numerous and are longer and terminally acute; pleural membranes rugose; abdomen about 3.4 mm long, 2 mm wide in mounted lectotype.

Chelicera: Yellow in color; inner margin very much S-shaped, a marked concavity near the base of the fixed finger making the base appear distorted; surface of base smooth; setae acuminate; the three setae of the flagellum bladelike and with a few long and slender serrations placed unilaterally at and near the end of each; length of chelicera 0.37 mm, width of base 0.235 mm; length of movable finger 0.32 mm. Fixed finger with outer margin distinctly convex; lamina exterior flatly convex in the central portion; tip of fixed finger very sclerotic, apical tooth with two conical denticles on the inner surface; inner margin of fixed finger with five or six retroconical teeth, the proximal one much reduced; serrula interior of 20 or more plates, the distal five or six modified. Movable finger a little curved; apical tooth very dark reddish brown and sclerotic; subapical lobe approximate to the apical tooth; a weak denticle may occur on the inner margin of the subapical lobe; galeal seta apparently not reaching the tip of the galea; both galeae terminally broken in lectotype; serrula exterior of between 25 and 30 plates, probably about 27 (position of serrulae precludes accurate count).

Palpus: Moderately slender; surface apparently unsculptured except for granules on the maxilla and very weak granules on a part of the chelal hand and on the fingers, these last somewhat conspicuous; setae stubby, short, a little longer on the chelal fingers than elsewhere. Maxilla about 0.8 mm long, 0.4 mm wide. Trochanter with stout pedicle; flexor margin well rounded; length 0.63 mm, width 0.38 mm. Femur very slender; pedicle barely indicated; outer margin flatly convex except more convex in the distal one-third; inner margin weakly concave in the basal one-half, weakly convex beyond but with a weak concavity near the distal end; length 1.5 mm, width 0.34 mm. Tibia stouter than the femur; pedicle about as wide as long; inner margin weakly convex in the basal half but very weakly concave beyond; outer margin flatly convex (to almost a little concave) in the basal two-thirds, more convex beyond; length 1.31 mm, width 0.352 mm. Chela with the flexor margin evenly convex from the pedicle to the finger base; extensor margin very flatly convex; hand widest near the center; fingers very slender, gently curved; length of chela without pedicle 2.25 mm, width 0.6 mm; length of hand without pedicle 1.08 mm, depth of hand 0.56 mm; movable finger 1.26 mm long. From the side, ventral margin weakly but evenly convex; dorsal margin somewhat irregularly convex; hand deepest in the distal one-third and little narrowed at the base of the fingers; fingers little curved. Marginal teeth of chelal fingers small, conical, cusp-bearing, about 70 on the movable and about 80 on the fixed finger. Movable finger with four tactile setae: *t* about one-sixth of the finger length from the tip; *st* near the midpoint of the finger; *sb* about one-fourth of the finger length from the base; *b* midway between *sb* and the finger base; nodus ramosus not observed. Fixed finger with *et* near tip of finger, *it* about one-sixth of finger length from tip; *est* almost one-third of finger length from tip; *ist* about one-third of finger length from base; *eb* less than one-sixth of finger length from base, *esb* a little nearer *eb* than *ist; isb* and *ib* separated by about three areolar diameters and a little distal to the level of *esb;* nodus ramosus not determined because of granular nature and color of finger.

Legs: Slender; setae stubby, short, peglike except on the flexor margin of the tibia, metatarsus, and telotarsus where the setae are stout, relatively long, and acuminate; surface of legs not sculptured. First leg with pars basalis deepest at the very distal end, flexor margin nearly straight except at the proximal end, extensor margin conspicuously convex near the distal third, distal one-third of podomere swollen, length measured along the extensor margin 0.63 mm, depth 0.19 mm; pars tibialis much shorter than the pars basalis, flexor margin convex, extensor margin little convex, length 0.4 mm, depth 0.185 mm; tibia somewhat S-shaped, length 0.54 mm, greatest depth across the distal end 0.13 mm; tarsal podomeres subcylindrical; metatarsus 0.38 mm long, 0.106 mm deep; telotarsus 0.325 mm long, 0.1 mm deep. Fourth leg with slender trochanter, flexor margin nearly straight, ex-



FIGS. 1–3.—*Garypus floridensis* Banks, 1895, male lectotype: 1, Anterior portion of carapace to show the eyes; 2, dorsal view of palp, tactile setae of chelal fingers omitted; 3, lateral view of chela, marginal teeth not shown.

FIGS. 4, 5.—*Pseudogarypus bicornis* (Banks, 1895) Ellingsen, 1908: 4, Spines of first pedal coxae (A, entire coxae of male lectotype; B, portion of coxae of tritonymph cotype); 5, dorsal view of palp; male lectotype, tactile setae of movable finger omitted.

FIGS. 6–8.—*Pseudozaona mirabilis* (Banks, 1895), n. comb., male lectotype: 6, End of movable cheliceral finger; 7, dorsal view of palp; 8, lateral view of chela, teeth of chelal fingers omitted.

tensor margin markedly convex, length 0.61 mm, depth 0.26 mm; pars basalis 0.38 mm long, 0.23 mm deep; pars tibialis with a straight flexor margin continuous with that of the pars basalis, extensor margin very weakly convex, length 0.96 mm, depth 0.27 mm; entire femur 1.25 mm long; tibia slender, weakly S-shaped, length 1.01 mm, depth greatest at the distal end and equal to 0.15 mm; tarsi subcylindrical; metatarsus 0.46 mm long, 0.13 mm deep; telotarsus 0.4 mm long, 0.11 mm deep; telotarsus with a stiff, weakly curved, and short pseudotactile seta placed 0.25 mm from the proximal margin of the podomere.

Genital complex: Posterior operculum with six to eight marginal setae and 12 to 14 setae in a compact double row on each lateral rim of the aperture; anterior operculum with nearly 35 setae, some scattered, but chiefly in a group just anterior to the aperture.

Female.—Examined only for details observable in the alcoholic specimen; apparently very similar to the male except that the palpal podomeres, especially the chela, are a little more slender. Body length about 4 mm. Palpal femur 1.5 mm long, 0.335 mm wide; tibia 1.33 mm long, 0.345 mm wide; chela without pedicle 2.25 mm long, 0.56 mm in width; chelal hand without pedicle about 1.08 mm long; movable finger at least 1.3 mm long.

Type locality.—Label accompanying collection reads: "under driftwood, ocean beach, nr. St. Lucie, Indian Riv., Fla., April 19, 1880. Coll. Hubbard. Type No. 4192 U.S.N.M."

Remarks.—This is the first detailed description of *G. floridensis*. Erroneously designated as this species, With (1907) described several individuals in a collection from Mustique Island. With's specimens are discussed under *G. withi*, new species, as given below.

Garypus withi, new species

Garypus floridensis With (*non* Banks, 1895), 1906, Danske Vid. Selsk. Skrifter, 7. Række, naturvidensk. og mathem., **3**: 41, fig. 9, pl. 2, figs. 4a–d; With, 1907, Journ. Linn. Soc. London, Zool., **30**: 70–72, pl. 9, figs. 26–28; *pro parte* Beier, 1932, Das Tierreich **57**: 220.

Under the name *G. floridensis*, With (1907) described in detail a pseudoscorpion species from Mustique Island, Windward Islands, West Indies. On comparing With's description with the lectotype of Banks's *G. floridensis*, it appears obvious that With did not have the Florida species described by Banks. For this reason, the species described by With is here redesignated as *G. withi*, new species.

The chief differences between *G. withi* and *G. floridensis* are as follows: The eyes of each side in *floridensis* are approximate but they are well separated in *withi* (With, 1907, fig. 26); the pars basalis of the first leg of *floridensis* is distally much more widened and bulging than in *withi* (With, 1906, fig. 9); the serrations of the flagellar setae are much coarser and longer in *floridensis* than in *withi* (With, 1906, pl. 2, fig. 4b); and the length of the movable chelal finger is equal to the length of the femur in *withi* but appreciably shorter than the femur in *floridensis*.

Suborder Monosphyronida Chamberlin, 1929

Superfamily Feaelloidea Chamberlin, 1931

Family Pseudogarypidae Chamberlin, 1931

Pseudogarypus bicornis (Banks, 1895) Ellingsen, 1908

Figs. 4, 5

Garypus bicornis Banks, 1895, Journ. New York Ent. Soc. **3**: 8–9; *non Pseudogarypus bicornis* Ellingsen, 1908, Boll. Lab. Zool., Portici, **3**: 218; *pro parte* Banks, 1911, Pomona Journ. Ent. **3**: 637; *non* Chamberlin, 1923, Ent. News **34**: 162–166, pl. 5, figs. 1–22; *non* Chamberlin, 1931, Stanford Univ. Publ., Biol. Sci., **7** (1); 231–232, figs. 6-E, 9-L, -N, 11-C, 14-E, 15-Q, 18-B, 24-D, 29-J, 38-K, 41-A, -B, -C, -D, 42-K, -L, 51-A, -B; *non* Beier, 1932, Das Tierreich **57**: 239–240; *pro parte* Roewer, 1937, *in* Bronn's Klass. und Ord. des Tierreichs **5** (div. 4, book 6): 271.

The type collection of this species consists of four individuals, of which one is a male lacking one of the palps. This specimen was mounted on a slide and is here designated as the lectotype. Of the other specimens, two are tritonymphs and one is an earlier nymph. One of the tritonymphs was mounted and is briefly described below. The earlier nymph is not in a condition suitable for study.

Male.—Description based on the lectotype. "Length, 2.5 mm. Brownish yellow, the cephalothorax and palpi darker than the other portions, a pale spot on the middle of the last two or three ventral segments. Cephalothorax narrow, somewhat triangular, much longer than broad, with a high elevated ridge each side, about parallel with the side margins, the

space between the ridges concave in anterior portion, convex behind; the anterior margin of the elevated portion is rounded; each lower anterolateral angle of the cephalothorax is prolonged into a conic tubercle, or horn, which is slightly longer than broad at base. There is a trace of the posterior suture, but the anterior one is very obscure; on each side there are two prominent eyes about their diameter apart, the posterior one on a tubercle and looking backward. The abdomen is broad and depressed, narrower at base than at posterior margin, broadest on the 6th segment, the segments plainly divided" (Banks, 1895). Carapace 0.7 mm long, 0.5 mm wide across the posterior margin; width of carapace at a level between the eyes 0.35 mm; abdomen 1.85 mm long, about 1.5 mm wide. Carapace and tergites granular; intertergal spaces and pleural membranes marked by wavy striations, pleural membranes rugose.

Chelicera: Yellowish brown in color; base stout; outer and dorsal surfaces granular; setae including the flagellar ones so damaged that observations could not be made. Fixed finger short, terminally acute, lamina exterior vestigial; movable finger short, stout, little curved, apical tooth conical and short, galeae and galeal setae broken from both chelicerae, serrula exterior with probably about 17 plates (condition of specimen precludes an exact count); length of chelicera measured from base to tip of movable finger 0.29 mm, width of base 0.14 mm; length of movable finger 0.105 mm.

Palpus: Slender; surface granular and marked by scalelike or netlike markings; setae evidently lost through long preservation in alcohol; orange or dark brownish yellow in color. Maxilla 0.49 mm long, 0.24 mm wide. Trochanter stout; pedicle very narrow; basal margin of trochanter beyond the pedicle nearly straight; flexor margin almost straight, extensor margin rounded; length of trochanter including pedicle 0.32 mm, width 0.22 mm. Femur subcylindrical; extensor margin flatly convex; flexor margin weakly concave in the basal portion, slightly convex near the distal fourth, weakly concave beyond; pedicle no longer than wide and fairly well set off from rest of podomere; length 1.09 mm, width 0.201 mm. Tibia pedicellate, gradually increasing in width toward the distal end; flexor margin basally concave, then a little convex, then weakly concave or nearly straight beyond the midpoint; extensor margin flatly convex; length 0.53 mm, width 0.19 mm. Chela with both flexor and extensor margins of the hand flatly to weakly convex; pedicle displaced a little towards the outer side; fingers very slender, long, and straight; length of chela without pedicle 1.32 mm, width 0.275 mm; chelal hand without pedicle 0.51 mm long; movable finger 0.8 mm long. Side view of chela not obtained. Teeth spaced, not contiguous; peglike, not conical; probably between 35 and 40 teeth on each chelal finger. Tactile seta of movable finger difficult to observe with certainty in present material; *t* appears to be somewhat more than one-fifth of the finger length from the tip, *st* is less than one-half as far from *t* as the latter is from the finger tip and much nearer to *t* than to *sb*; *sb* near the midpoint of the finger; *b* about as far from *sb* as *st* is from *t*. On fixed finger, *it* is about one-fifth of the finger length from the tip; *et* is twice as far from the finger tip as from the level of *it; ist* near the midpoint of the finger, *est* very little distal to *ist; esb* and *eb* about three areolar diameters apart and with *eb* about one-fifth of the finger length from the base; *isb* very little distal to the level of *esb* and *ib* very little distal to the level of *eb*.

Legs: Granular, surface marked by netlike lines; few remaining setae indicate that investing setae were short and acuminate, much longer on the flexor surface of the tarsi than elsewhere. First leg with each coxa displaying five to seven spines in the triangular posterior portion; coxa granular and marked as other podomeres of leg; trochanter with a narrow pedicle, rest of podomere globose, length 0.255 mm, depth 0.145 mm; pars basalis pedicellate, flexor margin nearly straight, extensor margin weakly concave, length 0.4 mm, depth 0.11 mm; pars tibialis with both margins weakly convex, length 0.34 mm, depth 0.114 mm; tibia markedly bent near the proximal one-third, flexor margin convex and extensor margin concave beyond the proximal one-third, length 0.32 mm, depth 0.084 mm; tarsus weakly curved, extensor margin a little convex, flexor margin a little concave, length 0.53 mm, depth 0.065 mm. Fourth leg with trochanter relatively slender, fusiform, length 0.37 mm, depth 0.14 mm; pars basalis and pars tibialis with much the same shape as in the first leg; pars

basalis 0.31 mm long, 0.1 mm deep; pars tibialis 0.45 mm long, 0.12 mm deep; tibia very slender, suddenly bent near the base, S-shaped, length 0.57 mm, depth 0.08 mm; tarsus markedly curved with the flexor margin evenly concave, length 0.72 mm, depth 0.065 mm.

Genital complex: A group of four setae on each lateral rim of the aperture; anterior operculum with 25 setae arranged in a compact group anterior to the aperture and, in addition, a few setae scattered on the surface; posterior operculum with nearly 25 setae in a compact group just posterior to the aperture, few other setae on the face of the operculum.

Female.—Not available for study.

Tritonymph.—Description based on one mounted tritonymph. As noted by Banks (1895) the general appearance of the tritonymph is not much different than that of the adult. Body length 2.3 mm; carapace 0.57 mm long, 0.5 mm wide; ocular breadth 0.33 mm; abdomen 1.75 mm long, 1.45 mm wide.

Chelicera: Much as in the adult; flagellum with two entire setae; plates of serrula exterior not determined; length of chelicera 0.27 mm, width of base 0.13 mm, length of movable finger 0.095 mm.

Palpus: General appearance, sculpturing, and chaetotaxy as in the male; podomeres a little stouter (except perhaps the chela) but of same general shape except that the outer margin of the tibia is a little concave near the center. Trochanter 0.28 mm long, 0.2 mm wide; femur 0.9 mm long, 0.185 mm wide; tibia 0.45 mm long; 0.175 mm wide, chela without pedicle 1.13 mm long, 0.24 mm wide; hand without pedicle 0.44 mm long, 0.225 mm deep; movable finger 0.7 mm long. In side view, both dorsal and ventral margins of the chelal hand are nearly straight to very weakly convex; fingers slender, the fixed nearly straight, the movable gently curved. Marginal teeth of chelal fingers peglike, not contiguous, much as in the male lectotype; fixed finger with 36 teeth, movable finger with 30 teeth. Movable finger with three tactile setae: *t* between one-third and one-fourth of the finger length from the tip, *st* within the distal one-half of the finger and about two-thirds as far from *t* as *t* is from the finger tip; the third seta, probably *sb*, located about one-third of the finger length from the base; *st* appreciably closer to *t* than to *sb*. Fixed finger with *et* about one-seventh of the finger length from the tip; *it* one-half as far from *et* as the latter is from the finger tip; *est* just proximal to the midpoint of the finger, *ist* very little distal to *est; esb* about one-fourth of the finger length from the base, *eb* about three areolar diameters basal to *esb; isb* a little basal to the level of *esb*, *ib* wanting; near the very tip of the fixed finger occur two setae, each a little less well developed than the regular tactile setae, these being suggestive of the pair of setae (designated usually as *xs*) found near the finger tip in certain groups of the Heterosphyronida.

Legs: Chaetotaxy and sculpturing as in the male; like the adult in general shape but a little smaller in size and many podomeres a little stouter. Coxa of each first leg with four spines like those in the lectotype; first leg with trochanter 0.21 mm long, 0.121 mm deep; pars basalis 0.32 mm long, 0.097 mm deep; pars tibialis 0.28 mm long, 0.095 mm deep; tibia 0.24 mm long, 0.075 mm deep; tarsus 0.43 mm long, 0.06 mm deep. Fourth leg with trochanter 0.34 mm long, 0.13 mm deep; pars basalis with extensor margin very weakly convex, length 0.24 mm, depth 0.099 mm; pars tibialis 0.37 mm long, 0.117 mm deep; tibia 0.45 mm long, 0.076 mm deep; tarsus 0.59 mm long, 0.063 mm deep.

Type locality.—Label with collection reads: "Specimen Ridge, Yellowstone Nat. Pk. Aug. 12, 1891. (In their cells moulting.) H. G. Hubbard. Type No. [U.S.N.M.] 4191."

Superfamily Cheliferoidea Chamberlin, 1931

Family Chernetidae Menge, 1855

Subfamily Chernetinae Beier, 1932

Tribe Hesperochernetini Beier, 1932

Dinocheirus arizonensis (Banks, 1901) Beier, 1933

Chelanops arizonensis Banks, 1901, Proc. U. S. Nat. Mus. **23**: 589, pl. 22, fig. 2; Chamberlin, 1923, Proc. California Acad. Sci. (ser. 4) **12**: 379–380, pl. 3, figs. 8, 30.

Hesperochernes arizonensis Beier, 1930, Ann. Naturh. Mus. Wien **44**: 213–214, fig. 9.

Epaphochernes arizonensis Beier, 1932, Das Tierreich **58**: 173–174, figs. 181, 182; Beier, 1933, Zool. Jahr. (Syst.) **64**: 537.

Dinocheirus arizonensis Beier, 1933, Zool. Anz. **104**: 100; Chamberlin, 1934, Pan-Pacific Ent. **10**: 128, figs. D, E, Q, T, U, Z; Roewer, 1937, *in* Bronn's Klass. und Ord. des Tierreichs **5** (div. 4, book 6): 302.

The U. S. National Museum cotype collection of this species contained three individuals. On examination, two of these were found to belong to *"Chelifer" hubbardi* Banks, 1901, a species that lives with *D. arizonensis*. The single individual of *D. arizonensis*, a female, has been indicated as the lectotype and is briefly described below.

Male.—Not in cotype collection; previously described by Chamberlin (1923b, 1934) and Beier (1930).

Female.—Since the female lectotype agrees well with the descriptions and figures given by Chamberlin (1923b, 1934) and Beier (1930), the present description is restricted chiefly to measurements. Body 4.2 mm long; carapace 1.2 mm long, nearly 1 mm wide across the posterior margin; eye spots very weak; 10 setae in an irregular row along the posterior carapacal margin; posterior transverse furrow a little closer to the posterior carapacal margin than to the median furrow. Abdomen with tergites except the eleventh divided; medial interscutal spaces wide and rugose; each first tergal half with seven setae, maximum number of setae on any half-tergite is nine; setae stout, terminally denticulate, not clavate; tergal scuta weakly granular. Sternites except the eleventh divided; very weakly sculptured; setae acuminate, long; each fourth sternal half with five or six setae; maximum number of setae on any one sternal half is 12; each anterior stigmatic plate with three setae, each posterior plate with two; pleural membranes marked by wavy, rugose striations.

Chelicera: Brown in color; fixed finger with five retroconical denticles on the inner margin; galea stout, probably six terminal and subterminal simple rami in the distal two-thirds of the galea; serrula exterior of 20 or 21 ligulate plates; length of chelicera measured from the tip of the fixed finger to the basal margin 0.31 mm, width of base 0.2 mm; movable finger nearly 0.25 mm long.

Palpus: Setae paucidenticulate to subacuminate except acuminate on fingers and maxilla; most setae relatively long. Trochanter 0.61 mm long, 0.37 mm wide; femur 0.96 mm long, 0.38 mm wide; tibia 0.96 mm long, 0.41 mm wide; chela without pedicle 1.61 mm long, 0.65 mm wide; chelal hand without pedicle 0.85 mm long, 0.65 mm deep; movable finger 0.9 mm in length. Marginal teeth of chelal fingers small, conical, cuspid; more than 50 marginal teeth on each finger, extending almost the entire length of the finger; movable finger with nine external and six internal accessory teeth; fixed finger with seven external and eight internal accessory teeth; accessory teeth confined in general to the distal one-half of each finger. Tactile setae of fingers as shown by Chamberlin (1934, fig. Q), except *t* and *st* of the movable finger are removed a little farther from the finger tip and on the fixed finger, *ist* is considerably distal to *est*.

Legs: First leg with trochanter 0.25 mm long, 0.2 mm deep; pars basalis 0.22 mm deep; pars tibialis 0.182 mm deep; entire femur 0.72 mm long; tibia 0.56 mm long, 0.13 mm deep; tarsus 0.51 mm long, 0.085 mm deep. Fourth leg with trochanter 0.45 mm long, 0.228 mm deep; pars basalis 0.37 mm long, 0.225 mm deep; pars tibialis 0.69 mm long, 0.24 mm deep; entire femur 0.96 mm long; tibia 0.81 mm long, 0.152 mm deep; tarsus 0.58 mm long, 0.105 mm deep, tactile seta 0.35 mm from the proximal margin of the tarsus.

Genital complex: Essentially as pictured by Chamberlin (1923b, pl. 3, fig. 30).

Type locality.—"Oracle, Ariz.; July, 1898; E. A. Schwarz; in *Dasylirion wheeleri*, U.S.N.M. 5431."

Pseudozaona mirabilis (Banks, 1895), n. comb.

Figs. 6–8

Chelifer mirabilis Banks, 1895, Journ. New York Ent. Soc. **3**: 4.
Chelodamus mirabilis R. V. Chamberlin, 1925, Bull. Mus. Comp. Zool. **57**: 237.
Parachelifer (?) *mirabilis* Beier, 1932, Das Tierreich **58**: 241; Roewer, 1937, *in* Bronn's Klass. und Ord. des Tierreichs **5** (div. 4, book 6): 313.

The U. S. National Museum collection consists of two cotypes, one male and one female. Both of these have been mounted on slides; the male is designated as the lectotype.

Male.—Description based on the lectotype. Body and carapace fairly stout; palps and legs very slender; body, carapace, and legs light yellowish brown, palps deep reddish brown; length of body 2.8 mm. Carapace moderately granular; anterior margin well rounded, other margins weakly convex; setae fairly numerous, multidenticulate, subclavate to virtually clavate; posterior margin with a row of 13 setae; transverse furrows well marked, the posterior

one much closer to the posterior carapacal margin than to the median furrow; eye spots not distinguished; length of carapace 0.96 mm, width greatest across the posterior margin and equal to 0.86 mm. Tergites of abdomen divided except the eleventh; not very sclerotic; weakly sculptured, the interscutal areas much more granular than the scuta themselves; setae subclavate to clavate, each fourth tergal half with six or seven setae, maximum number on any tergal half is seven. Sternites little sclerotic, very weakly sculptured; sternites 4 through 10 divided; setae acuminate; each fourth half-sternite with three or four setae; some central sternal halves with as many as 10 setae; each anterior stigmatic plate with three setae, each posterior plate with one; pleural membranes striated, very rugose; abdomen oval in shape, 1.85 mm long, 1.35 mm wide.

Chelicera: Dark yellow in color; moderately stout; subbasal seta very weakly denticulate, basal seta entire; flagellum of four setae, of which two are long, two are relatively short; on one chelicera, one of the short setae is broken while on the other chelicera, one of the long setae is missing; length of chelicera about 0.31 mm, width of base 0.17 mm; length of movable finger 0.255 mm. Fixed finger little curved, in poor condition for study; apparently five retroconical teeth on the inner margin of the finger. Movable finger somewhat straight; apical tooth unequally bicuspid; subapical lobe conical and located at very base of apical tooth; inner finger margin with one or two weak denticles at the level of the insertion of the galeal seta; serrula exterior apparently consisting of about 19 plates; galeal seta extending little beyond the tip of the galea; galea with six simple rami arranged along most of the length of the galea.

Palpus: Surface of maxilla and trochanter and the flexor surface of the femur and tibia finely granular, granules on the extensor surface of the femur hardly discernable, extensor surface of the tibia and the entire chelal hand and fingers virtually smooth; setae of maxilla acuminate; setae otherwise subclavate to clavate becoming paucidenticulate on the extensor side of the tibia and the chelal hand; setae of chelal fingers acuminate. "Palpi slender; trochanter pedicellate, tubercled above near tip; femur slightly longer than cephalothorax, gradually enlarged from base to near tip, inner margin straight, outer slightly convex; tibia three-fourths [sic!] as long, and slightly broader than femur, quite long pedicellate, outer margin slightly and evenly convex; inner margin convex at base, then nearly straight; hand about as long as tibia, slightly convex on outer margin, quite strongly and evenly on the inner margin, tapering to the fingers, which are about as long as the hand and quite strongly curved" (Banks, 1895). Measurements of palpal podomeres when seen from the dorsad as follows: trochanter 0.56 mm long, about 0.27 mm wide; femur 1.03 mm long, 0.26 mm wide; tibia 0.93 mm long, 0.28 mm wide; chela without pedicle 1.58 mm long, 0.39 mm wide; chelal hand without pedicle 0.82 mm long, 0.37 mm deep; movable finger of chela 0.86 mm long. From the side, chela is slender; pedicle displaced far towards the ventral margin of the hand; ventral margin of hand evenly and weakly convex, dorsal margin much more convex; fingers slender, the fixed one nearly straight, movable finger a little curved. Marginal teeth of chelal fingers small, conical, contiguous, cusp-bearing; many marginal teeth so worn or broken that an accurate count is difficult; probably 60 or more marginal teeth on each finger; apparently 10 external and two internal accessory teeth (some may be broken) on the fixed finger; accessory teeth of movable finger not accurately determined; all accessory teeth relatively weak. Movable finger with tactile seta *t* within the distal one-third of the finger; *sb* about one-fifth or a little less of the finger length from the base; *b* midway between *sb* and the proximal finger margin; *st* slightly proximal to the midpoint of the finger and a little nearer *t* than *sb*, nodus ramosus at a point midway between *t* and *st*. Fixed finger with *et* almost one-sixth of the finger length from the tip; *it* a little closer to *et* than the latter is to the finger tip; *est* located a little proximal to the midpoint of the finger, *ist* a little distal to the midpoint, *est* and *ist* separated by a distance less than the width of the finger at the level of *ist; ib* and *isb* about as far from the finger base as *it* is from the finger tip; *esb* a little proximal to the level of *ib*, about one-fourth of the finger length from the proximal finger margin; *eb* about four areolar diameters basal to *esb*.

Legs: Very slender; not noticeably sculptured; setae chiefly multidenticulate to sub-

clavate except acuminate on the flexor surface of the tarsi; tarsal claws simple. First leg with trochanter 0.23 mm long, 0.153 mm deep; pars basalis 0.17 mm deep; pars tibialis with flexor margin nearly straight, extensor margin a little convex, depth 0.133 mm; entire femur 0.67 mm long; tibia S-shaped, length 0.51 mm, depth, 0.098 mm; tarsus deepest near the center, extensor margin a little concave, flexor margin a little convex, length 0.51 mm, depth 0.076 mm. Fourth leg with pars basalis 0.3 mm long, 0.17 mm deep; pars tibialis with the two margins almost parallel, slightly curved throughout its length, 0.67 mm long, 0.17 mm deep; entire femur almost 0.9 mm long; tibia weakly S-shaped, very slender, 0.8 mm long, 0.11 mm deep; tarsus subcylindrical, a little narrowed distally, length 0.57 mm, depth 0.084 mm.

Genital complex: About 15 setae on the surface of the posterior operculum and four very small setae on the posterior rim of the aperture; anterior operculum with about 20 setae, an accurate count impossible in lectotype.

Female.—Description based on a single cotype. Essentially like the male; body length 3.6 mm. Carapace with 12 setae along the posterior margin; length of carapace 0.96 mm, greatest width across the posterior margin and equal to 0.97 mm. Tergites like those of the male; maximum number of setae on any tergal half is eight; sternites and stigmatic plates as in the opposite sex; length of abdomen about 2.65 mm, width 1.9 mm.

Chelicera: Essentially like that of the male; six well-developed but simple rami arranged more or less unilaterally along the entire length of the galea, the basal rami much longer than the more distal ones; length of chelicera about 0.32 mm, width of base 0.175 mm, movable finger about 0.26 mm long.

Palpus: Chaetotaxy, sculpturing, and shape of podomeres as in the lectotype. Measurements of palpal podomeres as follows: maxilla 0.56 mm long, 0.37 mm wide; trochanter 0.59 mm in length, 0.3 mm in width; femur 1.11 mm long, 0.28 mm wide; tibia 1 mm long, 0.31 mm wide; chela without pedicle 1.65 mm in length, width 0.425 mm; chelal hand without pedicle 0.85 mm long, 0.415 mm deep; movable finger at least 0.85 mm in length. Chelal fingers with marginal teeth much as in the lectotype; accessory teeth somewhat more numerous than in the male, about 12 external and eight to 10 internal accessory teeth on each finger; all teeth small, sometimes broken, and difficult to count accurately. Movable finger with *t* in the distal one-third of the finger, *st* near the finger midpoint; *sb* about one-fourth of the finger length from the base; *b* midway between *sb* and the proximal finger margin. Fixed finger with *est* and *ist* very near the midpoint of the finger, the former slightly proximal to the latter; *isb* and *ib* on about the same level; other tactile setae as in the male.

Legs: Shape of podomeres, chaetotaxy, and sculpturing much as in the male. First leg with trochanter 0.255 mm long, 0.17 mm deep; pars basalis 0.187 mm deep; pars tibialis 0.145 mm deep; entire femur 0.725 mm long; tibia 0.55 mm long, 0.11 mm deep; tarsus 0.51 mm in length, about 0.08 mm in depth; tarsus with both margins very weakly convex. Fourth leg with trochanter 0.41 mm long, 0.2 mm deep; pars basalis 0.342 mm in length, 0.175 mm in depth; pars tibialis 0.72 mm long, 0.182 mm deep; entire femur 0.98 mm long; tibia 0.85 mm in length, 0.125 mm in depth; tarsus 0.61 mm long, 0.091 mm deep.

Genital complex: Posterior operculum with 12 setae arranged in a marginal row; anterior operculum with a single row of 11 setae anterior to a group of 15 setae scattered on the face of the operculum.

Type locality.—The label accompanying the cotypes reads: "Indian Cave, Barren Co., Ky. July 24, 1881. H. G. Hubbard. U.S.N.M. 4195." Banks (1895) also reports the species from a cave at Pennington Gap, Va., but the specimens from this locality were not seen by the present writer.

Remarks.—The present species shows close relationship with the two other species of *Pseudozaona: P. communis* Beier, 1932, the genotype from Mexico, and *P. uniformis* (Banks, 1914) Hoff, in press, from Costa Rica. From *P. communis*, *P. mirabilis* differs by having a much smaller body; the palpal femur, tibia, and movable chelal finger measure about two-thirds of the length of the same structures in *P. communis*, and the palpal femur and tibia as well as the podomeres of the fourth leg are more slender in *P. mirabilis*. *Pseudozaona mirabilis* is little smaller than *P. uniformis* but the palpal femur and tibia, as well as the fourth leg, are much more slender.

Family Cheliferidae Hagen, 1878
Subfamily Cheliferinae Simon, 1879
Tribe Cheliferini Chamberlin, 1932

Parachelifer hubbardi (Banks, 1901) Chamberlin, 1932

Chelifer hubbardi Banks, 1901, Proc. U. S. Nat. Mus. **23**: 588–589, pl. 22, fig. 9; Chamberlin, 1923, Proc. California Acad. Sci. (ser. 4) **12**: 374–375, pl. 2, fig. 10, pl. 3, fig. 33.

Parachelifer hubbardi Chamberlin, 1932, Can. Ent. **64**: 19; Beier, 1932, Das Tierreich **58**: 240; Roewer, 1937, *in* Bronn's Klass. und Ord. des Tierreichs **5** (div. 4, book 6): 313.

Two specimens, one male and one female, of *Parachelifer hubbardi* were found in the type collection of *Dinocheirus arizonensis*, these two species having, according to Banks (1901), the same type locality and occurring in the same collection. While the present individuals may be from the original type collection, they are not labeled as types and therefore cannot be considered as such. The male has been mounted on a slide; the female was studied as an alcoholic. While these individuals are available, it seems advisable to give the following measurements and observations to supplement meager descriptions already existing in the literature.

Male.—Body 3.1 mm long; carapace 1.05 mm long, ocular breadth 0.51 mm; each seta of the carapace inserted on the side of a conspicuous tubercle, 18 of these tubercles between the posterior transverse furrow and the posterior carapacal margin and, in addition, there is present a keel-like structure resembling somewhat the lateral keels of the tergites and located at each posterolateral corner of the carapace; each of these structures bears two setae. All tergites except the last two with well-developed keels; tergites 1 through 4 not divided; 14 to 16 clavate setae on the central tergal halves; sternites 5 through 11 divided; posterior stigmatic plate with one seta, anterior stigmatic plate asetaceous; pleural membranes weakly and irregularly striate.

Chelicera: Fairly stout, dorsum of hand with netlike markings; basal seta with a few terminal and subterminal denticulations, subbasal seta with only one or two subterminal denticulations; longest flagellar seta with a few serrations along one edge; length of chelicera nearly 0.28 mm, width of base 0.16 mm, movable finger 0.19 mm long. Fixed finger with three strongly developed retroconical denticles near the distal end of the inner margin. Movable finger with moderately well-developed subapical lobe; serrula exterior of 18 or 19 ligulate plates; galea with four simple rami confined to the terminal one-half; galeal seta extending a little distance beyond the tip of the galea.

Palpus: Proximal podomeres moderately granular, chelal hand finely granular, chelal fingers almost smooth; setae short and multidenticulate to paucidenticulate, except acuminate on the chelal fingers; some setae on the basal half of the femur inserted on tubercles raised slightly above the general surface of the podomere. Shape of palpal podomeres much as shown by Chamberlin (1923b, pl. 2, fig. 10) for a female paratype at the Museum of Comparative Zoology. Palp of present specimen with measurements as follows: trochanter 0.57 mm long, 0.29 mm wide; femur 1.33 mm long, 0.235 mm wide; tibia 1.21 mm long, 0.263 mm wide; chela without pedicle 1.74 mm long, 0.45 mm wide; chelal hand without pedicle 0.89 mm long, 0.4 mm deep; movable finger 0.91 mm long. Tactile setae of movable finger with *st* a little proximal to the midpoint of the finger and a very little closer to *t* than to *sb*; *sb* just within the basal one-fourth of the finger, *b* midway between *sb* and the proximal finger margin; nodus ramosus about two areolar diameters proximal to tactile seta *t*. Fixed finger with *est* just proximal to the level of *ist* and both *est* and *ist* a little proximal to the midpoint of the finger; *it* midway between *ist* and the finger tip; *et* on a level midway between *it* and the finger tip; other setae near the base of the finger; nodus ramosus about midway between the levels of tactile setae *it* and *ist*.

Legs: Granular, becoming somewhat scalelike in sculpturing on the tibia and the tarsus of each leg; setae paucidenticulate becoming acuminate on the flexor surface of the tarsus of each leg; extensor surface of the pars tibialis and trochanter of each leg with some setae inserted individually on tubercles, more conspicuous on the pars tibialis of the fourth leg than elsewhere. First leg with measurements as follows: depth of pars basalis 0.21 mm; depth of pars tibialis 0.163 mm; entire femur 0.79 mm long; tibia 0.625 mm long, 0.135 mm deep; tarsus 0.545 mm long, 0.115 mm deep, the depth greatest across the distal end and

measured only to the base of the tarsal spine, not including the spine. Fourth leg with pars basalis 0.32 mm long, 0.2 mm deep; pars tibialis 0.93 mm long, 0.304 mm deep; entire femur 1.1 mm long; tibia 0.92 mm long, 0.152 mm deep; tarsus 0.69 mm long, 0.11 mm deep.

Genital complex: Posterior operculum with numerous (probably about 40) very fine setae well scattered on the face of the operculum and 10 setae on the very posterior rim of the genital aperture; anterior operculum very setaceous, bristly in general appearance.

Female.—In general like the male. Body 2.7 mm long; carapace 1.04 mm long, 1.12 mm wide across the posterior margin; diameter just behind the eyes 0.55 mm. Carapace tubercular much as in the male; tergites without keels; all tergites divided; about as many tergal setae as in the male. As near as can be determined from specimen in alcohol, the chelicera including the galea resembles closely that of the male. Palps shaped as in the male and like the one figured by Chamberlin (1923b, pl. 2, fig. 10); palpal podomeres slightly more slender than in the male; trochanter 0.6 mm long, 0.31 mm wide; femur 1.52 mm long, 0.25 mm wide; tibia 1.36 mm long, 0.285 mm wide; chela without pedicle 1.88 mm long, 0.435 mm wide; hand without pedicle 1.02 mm long; length of movable chelal finger 0.975 mm. Legs much as in the male; measurements not secured. Genital complex very simple.

Locality.—Oracle, Ariz., July 1898, in *Dasylirion wheeleri.*

Remarks.—A study of the present individuals of *P. hubbardi* indicates the advisability of calling attention to three particulars which perhaps should be deleted from the revised diagnosis of the genus *Parachelifer* as given by Beier (1932). At least one of our specimens disagrees with Beier's generic diagnosis as follows: The first four abdominal tergites are not always divided, this being contrary to Beier's statement "Tergite geteilt"; the tactile seta *ist* of the fixed chelal finger may be distal to *est* and not as Beier states: "Tasthaar *ist* etwas proximal von *est* gelegen"; and the setae of the palps are at the most subclavate and not as Beier indicates: "Borsten des Korpers und der Palpen kurz, gekeult."

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ICHTHYOLOGY.—*Distributional records for North American fishes, with nomenclatorial notes on the genus* Psenes.[1] ROBERT R. MILLER, U. S. National Museum.

In reducing the extensive backlog of unidentified fishes in the U. S. National Museum during the past year and a half, species were found that ranged beyond the published limits of their distribution, or, constituting rare records, seemed worth while for publication. The list, including fresh-water and marine species, treats the fresh-water forms first, and both groups are arranged in systematic sequence. Introduced as well as endemic species are included.

FRESH-WATER FISHES

CATOSTOMIDAE

Thoburnia rhothoeca (Thoburn)

This aberrant sucker was regarded by Hubbs (1930, pp. 43–45) as confined to the James River System, Virginia. Later Schultz (1939, p. 55, fig. 56) recorded it from the headwaters of the Mayo River, a tributary of the Roanoke River, also in Virginia. On the basis of collections made in Virginia in the summer of 1885 by Marshall McDonald, later U. S. Commissioner of Fishes, the known range of *Thoburnia* is now definitely extended to include the Kanawha and Potomac River drainages. Specimens of *T. rhothoeca* had, however, previously been assigned to the Kanawha (see Hubbs, 1930, p. 44) but the record was doubted by Hubbs who failed to take the species in that system. Later Hubbs and Raney (1944, p. 12) doubtfully included it in the Kanawha Basin.

The data for the specimens from the Kanawha Basin are as follows: U.S.N.M. no. 39529, 3 adults from Wolf's [=Wolf] Creek, Giles County, Va., collected in the summer of 1885 by McDonald. Wolf Creek enters the New River about 10 miles above the Virginia-West Virginia boundary line.

The record for the Potomac drainage is based on a single half-grown specimen (U.S.N.M. no. 132071) from War Branch, tributary to Dry River, near Rawley Springs, Rockingham County, Va., collected by McDonald in the summer of 1885; original number 137. Dry River is a tributary of the North Fork of the Shenandoah River. In addition to this definite record, there is a possibility that 12 yearling to adult *Thoburnia* (U.S.N.M. no. 131125) from "Waynesborough and vicinity," original number 20, collected by McDonald in 1885, also represent material from the Potomac drainage. Waynesboro is on the South Fork of the Shenandoah River in Augusta County, Va.

CYPRINIDAE

Agosia chrysogaster Girard

In the United States the genus *Agosia* (restricted to *Agosia chrysogaster* Girard, thus far the only known species of the genus) has not been recorded north of the Gila River Basin of southern Arizona, from which drainage it ranges southward into Sonora, Mexico. Its occurrence in Big Sandy River in Mohave County, Ariz., a tributary of Williams River, Colorado River Basin, is therefore of considerable interest. Fourteen young to small adults, U.S.N.M. no. 131685, were collected by Frank Stephens in Big Sandy Creek [=River] on July 17, 1902. That "Big Sandy Creek" is the same as what is now called Big Sandy River is proved by Stephens's account of his travels in 1902 (Condor **5**: 75); for this reference I am grateful to Lawrence M. Huey, of the Natural History Museum, Balboa Park, San Diego, Calif. Although the identification to genus is without question (teeth 4–4; scale with radii on all fields; maxillary with a barbel; anal elongate, with 7 rays; mouth small, subterminal, nearly horizontal), the specific allocation is uncertain, for the specimens are mostly small and poorly preserved. Except for a few channel forms and *Plagopterus argentissimus* Cope, the fish fauna of the Gila River (including the Colorado below the Gila) is remarkably unlike that of the vast remainder of the Colorado River Basin.

Hesperoleucus mitrulus Snyder

The most recent account of the distribution of this species (Schultz and DeLacy, 1935,

[1] Published by permission of the Secretary, Smithsonian Institution. Received February 15, 1946.

p. 379) gave the range as streams tributary to the north end of Goose Lake, Lake County, Oreg. It has been known for several years, however, that *mitrulus* is one of the distinctive elements of the upper Pit River fauna (Sacramento System), to which Goose Lake was tributary in historic times, for several collections of this species from the vicinity of Likely and Alturas, Modoc County, Calif., are preserved at the University of Michigan. The lowermost record in the Pit River for *mitrulus* is based on two adults, U.S.N.M. no. 132089, collected by the late J. O. Snyder in Big Valley, just north of Bieber, Lassen County, Calif. The small fins (dorsal 8, anal 7) and the presence of radii on all fields of the scales have been used to distinguish *mitrulus*, but similar characters occur in some headwater populations of *symmetricus* on the west slope of the Sierra Nevada and these two species may eventually be found to intergrade.

Rhinichthys osculus (Girard)

Now that *Apocope* is relegated to the synonymy of *Rhinichthys* (Hubbs, 1940, p. 200), where Gilbert (1893, p. 229) properly placed it years ago, the genus *Rhinichthys* comprises one of the commonest elements of the western fresh-water fish fauna. With few exceptions, the western members have lately been regarded by Hubbs and others as forming a widespread species, *R. osculus*. In examining the types of *Argyreus osculus* (U.S.N.M. no. 50), I find that in two of the three specimens there is a definite, though weak, frenum; thus at least five forms of *R. osculus* (subgenus *Apocope*) are now known with this structure varyingly developed (always strongly developed in the subgenus *Rhinichthys*).

Although this species is known from streams of the Pacific coast as far south as the Santa Ana River drainage (Culver and Hubbs, 1917, p. 83, as *Agosia nubila carringtonii*), it heretofore has not been recorded from the Santa Clara River Basin, just to the north. Neither is it known to occur in the Ventura or Santa Ynez Rivers, the next drainages northward, but it has been taken recently (by R. G. and R. R. Miller in 1940; material at the University of Michigan) in the Cuyama River Basin, next to the north.

On October 14, 1945, 388 young to adult (U.S.N.M. no. 132342) were seined by R. G. Miller and Larry Gianettoni, about 12 miles up Elizabeth Lake Canyon from U. S. Highway 99, and 144 young to adult (U.S.N.M. no. 132346) were collected in Castaic Creek, 5½ miles up from the same highway; both localities are in Los Angeles County, north of Saugus. The stream in Elizabeth Lake Canyon, to which Castaic Creek is tributary, joins the Santa Clara River during floods just below Newhall Ranch, or about 4 miles upstream from the Los Angeles-Ventura County line. In addition, four adults were seined by the same collectors in the Santa Clara River between U. S. Highway 99 and the railroad bridge a short distance upstream, Los Angeles County, on October 21, 1945; U.S.N.M. no. 132351. Despite the fact that the streams of the Santa Clara River Basin have been collected rather thoroughly in habitats that appear to be well suited to *Rhinichthys* below the Los Angeles-Ventura County line during the past decade, and also in the main river from that point to its source region, no *Rhinichthys* were found heretofore. The possibility that the species was introduced as bait by trout fishermen must therefore be seriously considered. However, the absence of this genus in previous collections from the Santa Clara Basin is not logically explained, for the other two fresh-water fishes of southern California, the sucker *Pantoseus santa-anae* Snyder and the minnow *Gila orcuttii* Eigenmann and Eigenmann, are abundant there.

Chrosomus oreas Cope

Dr. Leonard P. Schultz has kindly called my attention to what appears to be the first collection of this species from the New River in western Virginia. It is based on U.S.N.M. no. 107582, 12 specimens 36.5 to 54 mm. in standard length, collected by L. P. Schultz and E. D. Reid on July 16, 1938, in Little River and Sugar Run (tributaries to New River, Kanawha system) above Snowville, Pulaski County, Va. Examination of preliminary counts and measurements made by Dr. Schultz on this material and three other collections in the Roanoke River system (from which the species was described) indicates that the New River sample is very slightly finer-scaled. Raney (in Hubbs and Raney, 1944, p. 12) also took this species in the Kanawha system, and it is known elsewhere from the headwaters of the James and Roanoke Rivers, Va.

AMEIURIDAE

Ameiurus natalis (LeSueur)

In a recent account of exotic fishes in the Pacific Northwest, Chapman (1942, pp. 12–13) listed only *Ameiurus nebulosus* and *Ameiurus melas*. A third introduced species, the yellow bullhead or catfish, *Ameiurus natalis*, is now recorded for the first time from Oregon. The record is based on an adult, U.S.N.M. no. 108817, from McBee Lake, Benton County, collected by Stuart J. Couper. The letter by Mr. Couper transmitting this specimen was written on February 24, 1939, but no date of collection was given. It agrees well with the diagnosis of *A. natalis* by Hubbs and Lagler (1941, p. 62) for it has 25 anal rays, a broadly rounded caudal fin, and whitish mental barbels. The yellow bullhead was not mentioned in the papers covering Oregon fishes by Schultz and DeLacy (1935), Schultz (1938), or Griffiths (1940).

MARINE FISHES

NOMEIDAE

Psenes regulus Poey

Since widespread distribution is characteristic of oceanic fishes, it is therefore not surprising that this species, previously known north of the coasts of Cuba only by a single record from off Beaufort, N. C. (Smith, 1907, p. 223), is represented by four small to large adults taken off North and South Carolina. The data for these specimens, all collected by the *Albatross*, is as follows: 2 small to large adults, U.S.N.M. no. 132237, station 2603, lat. 34°38′30″ N., long. 75°33′30″ W., taken at the surface approximately 55 miles east of Cape Lookout, N. C., on October 18, 1885; 1 adult, U.S.N.M. no. 131629, station 2626, lat. 32°27′30″ N., long. 77°20′30″ W., collected approximately 155 miles east of Charleston, S. C., on October 21, 1885; 1 adult, U.S.N.M. no. 39329, station 2628, lat. 32°24′00″ N., long. 76°55′30″ W., collected about 175 miles east of Charleston on the same date. U.S.N.M. no. 131629 was taken over a depth of 353 fathoms and U.S.N.M. no. 39329 over a depth of 528 fathoms. The large beam trawl used by the *Albatross* to collect these specimens had no closing device and therefore fished from the bottom to the surface. *P. regulus* is obviously not a deep-water fish and was evidently taken by the trawl at or near the surface, as were the two specimens represented by U.S.N.M. no. 132237.

In all four, the dorsal rays are XI, I, 15 and the anal rays III, 15 and there are about 50 to 55 scales in the lateral line; the large round to oblong dark spots, well portrayed by Goode and Bean (1895, fig. 229), and the shape and proportions of the body and its parts agree very well with the original description of *regulus* by Poey.

No one seems to have noticed that Goode and Bean (1895, p. 221, fig. 229, pl. 63) recorded this species under the name *P. maculatus*, based on the third specimen listed above (U.S.N.M. no. 39329). Not only was this fish misidentified by them but also their records for both *P. pellucidus* and *P. "maculatus"* are confused and erroneous. The specimen they credit (in paragraph 3, p. 221) to the account of *pellucidus* is actually the fish referred by them to *maculatus*, for the longitude, latitude, and depth are precisely as given for U.S.N.M. no. 39329, on which figure 229 was based (original drawing in files of Division of Fishes). The data given in paragraph 4, "N. lat. 27°49′, W. long. 76°12′, over a depth of 633 fathoms," obviously were meant to go with the account of *pellucidus* and to apply to figure 228, not to figure 229. In addition, however, these data are almost surely erroneous, for figure 228 was based on U.S.N.M. no. 35415, station 2171, lat. 37°59′30″ N., long. 73°48′40″ W., collected at the surface by the *Albatross* on July 20, 1884. Unfortunately, this specimen was discarded some years ago, but the catalogue book, the data on the original drawing, and the index card all agree on this location and disagree with the one given by Goode and Bean.

Psenes pellucidus Lütken

The type locality of this species seems to have been generally overlooked or misinterpreted.[2] It was described by Lütken (1880, p. 516, 1 fig.) from the Straits of Surabaja, Java, hence in the Indo-Pacific (not the At-

[2] Fowler (1936, p. 664, footnote) pointed out the correct type locality under the account of *P. maculatus* (note that his figure 298 is really of *P. regulus* for it was based on figure 229 of Goode and Bean).

TABLE 1.—VARIATION IN DORSAL FIN RAYS IN SPECIES OF PSENES[1]

Species	Dorsal spines				Dorsal soft rays												No.
	IX, I	X, I	XI, I	XII, I	22	23	24	25	26	27	28	29	30	31	32	33	
pellucidus	—	—	—	1[2]	—	—	—	—	—	—	—	—	—	—	—	1[2]	1
"pellucidus"[3]	—	—	—	14	—	—	—	—	—	—	—	1	9	3	1	—	14
edwardsii	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	1
cyanophrys[4]	4	2	—	—	—	—	—	1	1	3	1	—	—	—	—	—	6
pacificus[5]	3	—	—	—	—	—	—	—	?	2	?	—	—	—	—	—	3
chapmani[6]	—	X	—	—	X	X	—	—	—	—	—	—	—	—	—	—	7?
"maculatus"	—	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	2

[1] The dorsal fin formula for *P. regulus* Poey is XI, I, 15.

[2] Lütken did not differentiate between spines and soft rays, merely stating that the first dorsal had 12 rays, the second dorsal 34; I assume the 12 rays are spines and that there is one spine in the second dorsal, leaving 33 soft rays. Regan (1902, p. 125) wrote the formula as XI, I, 34.

[3] American material, North Atlantic; perhaps distinct from true *pellucidus* (Indo-Pacific; see text).

[4] Including count by Hubbs (1929, p. 36) of IX, I, 25.

[5] Meek and Hildebrand (1925, p. 409) wrote that the soft dorsal rays of *pacificus* varied from 26 to 28. On reexamining the three types (U.S.N.M. nos. 82196-97) I count 27 in two, but the rays are broken in the third specimen which may have had 26 or 28.

[6] Fowler (1906, p. 119) did not indicate how many specimens were counted or what the individual frequencies were.

lantic).[3] The American form, also pellucid, which has been passing under the name *pellucidus*, may really be distinct from the Indo-Pacific species. If so, the name *edwardsii* may be available for it, since it is doubtful if Eigenmann's species is distinct from American *"pellucidus"* (Tables 1 and 2). With the insufficient material at my disposal (particularly the lack of Indo-Pacific specimens) it is probably best to continue recognizing *pellucidus* and *edwardsii* as currently understood. A revision of *Psenes* and its close allies is obviously needed. The grouping shown in Tables 1 and 2 seems to give interesting leads toward such a study.

The groups may be briefly and tentatively characterized as: (1) *pellucidus*–group, with an increased number of fin rays, very fine scales (about 120–140), and transparent body; (2) *cyanophrys*–group, with an intermediate number of fin rays and large scales (about 50–65); and (3) *"maculatus"*–group, with few fin rays and large scales (about as in *cyanophrys*–group). *Psenes regulus* is so different in coloration and fin-ray number that it is evidently not very closely related to any of the above.

The records for *P. "pellucidus,"* all based on collections taken by the *Albatross*, are as follows: U.S.N.M. no. 83793, 3 young to half-grown, station 2711, lat. 38°59′00″ N., long. 70°07′00″ W., September 16, 1886, about 265 miles east of Cape May, N. J.; U.S.N.M. no. 83795, 1 young, station 2102, lat. 38°44′00″ N., long. 72°38′00″ W., November 5, 1883, about 125 miles east of Cape Henlopen, Del.; U.S.N.M. no. 83794, 1 young, station 2742, lat. 37°46′30″ N., long. 73°56′30″ W., September 17, 1887, about 85 miles east of the peninsula of Maryland; U.S.N.M. no. 38172, 4 half-grown, station 2724, lat. 36°47′00″ N., long. 73°25′00″ W., October 23, 1886, about 150 miles east of Cape Henry, Va.; U.S.N.M. no. 38192, 4 young to adult, station 2731, lat. 36°45′00″ N., long. 74°28′00″ W., October 25, 1886, about 95 miles east of Cape Henry, Va., U.S.N.M.

TABLE 2.—VARIATION IN ANAL RAYS IN SPECIES OF PSENES[1]

Species	Number of anal soft rays										No.
	22	23	24	25	26	27	28	29	30	31	32	
pellucidus[2]	—	—	—	—	—	—	—	—	1	—	1
"pellucidus"[3]	—	—	—	—	—	—	—	3	7	3	1	14
edwardsii	—	—	—	—	—	—	—	1	—	—	—	1
cyanophrys[4]	—	—	—	—	4	1	1	—	—	—	—	6
pacificus	—	—	—	—	1	2	—	—	—	—	—	3
chapmani	—	X	X	X	—	—	?[5]	—	—	—	—	7?
"maculatus"	2	1	—	—	—	—	—	—	—	—	—	3

[1] In all material examined by me the anal fin was preceded by three spines; this agrees with published accounts. In *P. regulus* the anal fin formula is III, 15.

[2] Despite the fact that Lütken clearly indicated the anal fin formula (3.31), this has been repeatedly written as III, 34.

[3] American material, North Atlantic; perhaps distinct from true *pellucidus* (Indo-Pacific; see text).

[4] Including count by Hubbs (1929, p. 36), of III, 26.

[5] Note that Fowler (1906, p. 121) in his description of *chapmani* wrote, "Larger example with 28 rays." I assume he was speaking of anal rays.

[3] I am greatly indebted to Dr. Adam Bøving, associate in zoology, U. S. National Museum, for translating Lütken's account of *P. pellucidus* and *P. maculatus*.

no. 131524, 1 half-grown, station 2402, lat. 28°36′00″ N., long. 85°33′30″ W., March 14, 1885, in the Gulf of Mexico about 80 miles south of Cape San Blas, Fla.

Psenes maculatus Lütken

The common application of this name to the Atlantic *Psenes*, which has few (usually 22 or 23) soft rays in both dorsal and anal fins, must now be seriously questioned. Lütken clearly indicated (1880, p. 519) that his species (or at least the largest specimen he described) has teeth on the palatine bones and at least a single tooth on the vomer. According to current ideas, the genus *Psenes* is distinguished from *Nomeus* and *Cubiceps* by lacking teeth on both the palatine bones and the vomer. Lütken strongly suspected that his "*Psenes maculatus*" was really the young stage of a *Cubiceps*, but Collett (1896, p. 31) insisted that this interpretation was wrong, although he seems to have overlooked or ignored the palatine and vomerine dentition. I have not observed palatine (or vomerine) teeth in the few specimens representing six or more species of *Psenes* I have examined (Tables 1 and 2); neither have I seen in *Psenes* a body form as slender as that portrayed by Lütken (1880, pl. 5, fig. 2) for his largest specimen (94 mm., total length). On the basis of these data it seems highly improbable that Lütken's *maculatus* belongs to the genus *Psenes*. Without a revisionary study and a more thorough search of the literature than I have made, I do not think it wise to substitute a new specific name for what has been passing as *Psenes maculatus*. There is a good chance that a name may already be available. I therefore refer to the species in my tables as "*maculatus*."

The data for the National Museum material of "*maculatus*" are as follows: 2 young (identity uncertain) and 1 adult, U.S.N.M. no. 83792, station 2711, lat. 38°59′00″ N., long. 70°07′00″ W., taken in the open Atlantic directly east of Cape May, N. J. and south of Nantucket Island, Mass., by the *Albatross* on September 16, 1886; 1 young, U.S.N.M. no. 131517, station 2223, lat. 37°48′30″ N., long. 69°43′30″ W., collected by the *Albatross* in the open Atlantic east of Delaware and south of Nantucket Island, on September 7, 1884; and 1 young, U.S.N.M. no. 126652, from "sargasso weed" in the open Atlantic east of the West Indies, lat. 21° N., long. 51° W., collected by Dr. C. C. Craft on the yacht *Carnegie*.

Psenes cyanophrys Cuvier and Valenciennes

Hubbs (1929, pp. 34–36) added this species to the known fauna of continental United States, but I am not aware of any other published records of *P. cyanophrys* from our North Atlantic coast. The following northernmost American record of this species is therefore of interest: 1 large adult (117 mm., standard length), U.S.N.M. no. 64120, seined at No Man's Land, an island just south of the western tip of Martha's Vineyard, Mass., by Vinal N. Edwards in 1904. The distinctive coloration of *cyanophrys*—longitudinal, lighter streaks between the scale rows following the outline of the gently arched lateral line above but running horizontally below the lateral line—is well developed in this specimen, and it agrees well in other characters with current definitions of *cyanophrys*.

GADIDAE

Urophycis chesteri (Goode and Bean)

Until recently this deep-water species has been regarded as ranging from the Gulf of St. Lawrence southward to off Cape Lookout, N. C. Dr. William H. Longley listed 29 specimens from Tortugas, Fla. (*in* Longley and Hildebrand, 1941, p. 38), but these specimens have not been found, and hence their identity can not now be verified.

The southernmost record based on material available for examination appears to be an adult (U.S.N.M. no. 132240) 207 mm. in standard length, collected by the *Albatross* at station 2674, lat. 32°32′00″ N., long. 77°17′00″ W., in the open Atlantic approximately 165 miles east of Charleston, S. C., over a depth of 316 fathoms, on May 6, 1886. The specimen shows the characteristics of this species: a much-prolonged third dorsal filament, the depressed length of which (measured from origin of first dorsal) enters about 2.2 times in the standard length; very elongated pelvic fins, the length of the right fin entering the standard length 1.6 times; and approximately 90 scales crossing the lateral line, but as all the scales are rubbed off an accurate

count is not possible. There are about 14 or 15 gill rakers, and the short chin barbel enters about 2½ times in the length of the orbit. The fin rays are: Dorsal 9+59, Anal 50 or 51.

Urophycis regius (Walbaum)

The spotted ling, *Urophycis regius*, has until lately been known to occur from Nova Scotia to South Carolina (Hildebrand and Cable, 1938, p. 612). However, Dr. W. H. Longley secured 19 specimens in 60 to 283 fathoms off Tortugas, Fla. (Longley and Hildebrand, 1941, pp. 37–38). None of these specimens have been found, but the occurrence of *U. regius* as far south as Florida is now fully substantiated by specimens in the U. S. National Museum. The southern records comprise the following: 1, U.S.N.M. no. 89528, from Savannah Harbor, Ga., collected by Ivan R. Tomkins on February 22, 1930; 2, U.S.N.M. no. 89690, same place and collector, June 1930; 1, U.S.N.M. no. 59028, from Tybee Roads, near Savannah, Ga., collected by the *Fish Hawk* in 1891; 3, U.S.N.M. no. 91438, 16 miles off Sapelo Island lighthouse, about 40 miles south of Savannah, Ga., collected by the *Fish Hawk*, station 8259, on May 3, 1915; 3, U.S.N.M. no. 131251, ½ mile off Sea Island, near Brunswick, Ga., taken by Raymond E. and Bette Johnson in a shrimp trawl, at 2 to 4 meters depth, on March 17, 1945; 28, U.S.N.M. no. 127461, St. Simon Sound, near Brunswick, Ga., collected by W. W. Anderson on November 21, 1930; 2, U.S.N.M. no. 116725, off Fernandina, Fla., on shrimp grounds, taken by DeSmidt on November 8, 1918 (in very poor condition; identification not positive); 1, U.S.N.M. no. 73012, in Gulf Stream off Cape Florida, Fla., 4 miles northeast by east of Fowey Rock Light, over a depth of 156 fathoms, *Fish Hawk* station 7518, March 30, 1903; 1, U.S.N.M. no. 73011, Gulf Stream off Key West, Fla., Station 7279, lat. 24°21′55″ N., long. 81°58′25″ W., over a depth of 98 fathoms, collected by the *Fish Hawk* on February 14, 1902.

In the short chin barbel (as short as or shorter than pupil), head not notably depressed (depth about equal to width), moderate scales (less than 100), few rays in first dorsal (usually 8 or 9), and in coloration, these specimens agree very well with the diagnosis by Hildebrand and Cable (1938, p. 613).

Urophycis floridanus (Bean and Dresel)

The known range of the Florida ling, *Urophycis floridanus*, was given by Hildebrand and Cable (1938, p. 612) as Beaufort, N. C., to Pensacola, Fla. (the type locality). It is not surprising that this range is now extended to Galveston, Tex., on the basis of the following: 1, U.S.N.M. no. 131191, one mile south of Timbalier Island (south of New Orleans), La., taken in a shrimp trawl at a depth of 5 fathoms by Horace L. Whitten, February 5, 1945; 2, U.S.N.M. no. 120087, from Galveston, Tex., taken in a shrimp trawl by J. L. Baughman (specimens received from shrimp fishermen) in 1941.

These specimens are in complete agreement with the diagnostic characters of this species as cited by Hildebrand and Cable (1938, p. 613): Chin barbel always longer than pupil; scales in 110 to 130 oblique series above lateral line; dorsal 12 or 13+54 to 59; anal rays 40 to 49; lateral line in a black streak interrupted by pale spots; first dorsal dusky or black (especially distally), but not margined with white as in *regius*.

SCOPHTHALMIDAE[4]

According to Norman (1934, p. 270) South Carolina is the southern limit of the known range of the windowpane, *Scophthalmus aquosus* (Mitchill), long known under the name *Lophopsetta maculata*. The following lots of this easily recognized species are from Georgia: 2, U.S.N.M. no. 131253, taken in a shrimp trawl at 2 to 4 meters ½ mile off Sea Island, near Brunswick, by Raymond E. and Bette Johnson on March 17, 1945; 2, U.S.N.M. no. 119251, collected in St. Simon Sound, near Brunswick, on October 12, 1930; and 2, U.S.N.M. no. 127496, taken at Brunswick in 1930. The tast two collections were made by W. W. Anderson.

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[4] I follow Hubbs and Hubbs (1945, pp. 244, 248) and Hubbs (1945, pp. 7–8, fig. 1) in giving this group of North Atlantic flatfishes family ranking.

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ETHNOLOGY.—*The Cherokee Green Corn Medicine and the Green Corn Festival.*[1]

JOHN WITTHOFT, University of Pennsylvania. (Communicated by W. N. FENTON.)

The Cherokee in former times celebrated a major harvest festival, primarily concerned with the ripening corn. This was the New Corn Festival, held in August when the green corn first became fit to eat. It marked the beginning of the winter half of the year. This festival appears to have been similar to the Green Corn Festival or Busk of the Creek Indians, of which we have much more reliable and complete accounts, but the Cherokee data are sparse, and there are few characteristics by which we can distinguish the Green Corn Festival of the Cherokee from that of the Creek.[2]

Among the Cherokee of Qualla Reserve, North Carolina, the Green Corn Festival seems to have been the last important major ceremony to survive. Mooney, in 1914, states that he saw the last Green Corn Dance performed there in 1887 and mentions that he had seen the performance of a related festival as late as 1914. This account follows.

By special permission of some of the Indian priests Mr. Mooney was able to be present for the second time at the family ceremony of invoking the blessing upon the new corn and on those about to partake of it for the first time. This ceremony, probably never witnessed by another white man, is still strictly observed in private at their homes by most of the full-blood families before tasting the new corn of the season, the priests who conduct the rite going, while yet fasting, from house to house through the settlement for that purpose. The so-called Green Corn Dance, the great tribal celebration of thanksgiving for the new corn, was last performed in 1887, on which occasion Mr. Mooney was also present.[3]

Opportunity was also afforded for special studies and observations, particularly of the ceremonial "going to water," and augury with the beads to forecast the health prospect and life-span of each member of the family, before partaking of the first corn of the new crop.[4]

Dr. F. G. Speck, during the course of his extensive study of surviving Cherokee dances, found the opportunity to observe and describe a third Green Corn Ceremony still in existence in the Big Cove Community of Qualla Reserve.[5] This ceremony,

[1] This study was made possible by a grant-in-aid, for field work among the Eastern Cherokee, from the Department of Anthropology Research Funds of 1944 and 1945 of the University of Pennsylvania. Received February 7, 1946.

[2] The only original accounts of the Cherokee Green Corn Festival with which I am familiar are: The unpublished description by John Howard Payne, written in 1836, included in the Payne Manuscripts in the Ayer Collection, Newberry Library, Chicago, and described by Dr. William H. Gilbert (*The Eastern Cherokee.* Bur. Amer. Ethnol. Bull. **133**: 388–401. 1943); and the account dictated by Charles Hicks, which is presented later in this paper. A comparative study of the Green Corn and harvest festivals of the Southeastern Indians, now being carried on by the author, may result in a better understanding of the nature and function of these ceremonies, but until such an investigation has progressed further, we must leave the comparison in this incomplete state.

I have in this paper attempted to restrict the term "Green Corn Festival" to the old periodic green-corn observance and "Green Corn Feast" to the modern curing ceremony, and "Green Corn Medicine" to the herb tea now used by itself and formerly employed as a feature of the Green Corn Festival.

[3] *Explorations and field work of the Smithsonian Institution for 1914.* Smithsonian Misc. Coll. **65** (6): 72–73.

[4] *Explorations and field work of the Smithsonian Institution for 1913.* Smithsonian Misc. Coll. **63** (8): 64.

[5] SPECK, F. G., Manuscript on *Eastern Cherokee songs and dances.*

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however, is not held at any fixed time and seems to have lost all connection with the cycle of the agricultural year. It is performed for curative purposes at whatever time it may be needed by persons suffering from specified ailments and is accompanied by a feast provided by the patients and their families. Apparently one sequence of the old agricultural festival has continued its existence after the passing of the Green Corn Festival and has come into new associations, perhaps long before the major, fixed ceremony had been discontinued.

Will West Long, of Big Cove, dance leader and authority on Cherokee tradition, is familiar with the current Green Corn Feast, and he functions as a leader on occasions when its performance is required. He has not seen the periodic Green Corn Festival. However, drawing on information which he received from his mother, and from his older brother, he was able to supply some information about this extinct ceremonial complex.

Will West Long's information reveals that this Green Corn Festival was held the night before the first corn was to be eaten. A medicine was first prepared, and an emetic was drunk by everyone present, followed by "going to water."[6] Then the medicine was administered to all who were present at the ceremony. A formula may have accompanied the going to water,[7] but no formula was required as an accompaniment to the medicine that followed.[8] Then a series of "animal" and social dances followed, lasting all night. This dance series seems to have been the same as that found in the Green Corn Feast used for curative purposes as described by Dr. Speck.

In the morning the conjuror who served as dance leader took all the people "to water" again and then examined each person with the beads and cloth to see whether they would live until the next year's Green Corn Festival. In this form of divination the conjuror places two beads (glass beads were used in recent times, but these are said to have replaced certain seeds that the Cherokee formerly obtained at a distance), one black and one red or white, on a piece of white cloth, the red (or white) bead to the conjuror's right. The cloth is provided by the person being examined and is given to the conjuror as a token payment. The conjuror then speaks to the beads after a fixed formula, asking first the red bead if the person is to live until the next year and then asking the black bead the same question. If the red bead moves by itself, the person is expected to survive the year, and if the black bead moves, the patient will not live the year out.[9]

In case the divination indicated that someone would not live that long, a similar Green Corn Feast was held at night. Dances

---

[6] The "going to water" ordeal is an important item in Cherokee ritual. The purifying nature of the river was resorted to as a cleansing and protective symbol at almost any crisis in the life of the Cherokee individual or community. This formalized ceremonial bathing in the water of the river became an integral portion of many ceremonial and curative procedures.

For a fuller account of this significant phase of Cherokee tradition see: Mooney, James, *The Cherokee river cult.* Jour. Amer. Folklore **13**: 1–10. 1900; Mooney, James, and Olbrechts, Franz, *The Swimmer manuscript.* Bur. Amer. Ethnol. Bull., **99**: 22–23. 1932.

[7] Mooney and Olbrechts, *The Swimmer manuscript:* 232–234, give a formula like those used in this connection and, 289–291, a formula used when "going to water" on the following morning.

[8] Cherokee medicinal practice and certain phases of Cherokee ritual depended in part on traditional spoken charms, called prayers and formulas by the Cherokee. These are memorized, must be spoken very exactly, and are the property of a semiprofessional "conjuror" class. These formulas have been written in the syllabary invented by Sequoya about 1820, and some are no longer understandable because of the archaic forms preserved in them. It is probably the ritual language of these formulas to which Hicks refers as a forgotten language in the account previously quoted.

For a thorough study of Cherokee formulas and their functions, see: Mooney and Olbrechts, *The Swimmer manuscript.*

[9] Divination seems to have been an important feature in Cherokee culture; it may even once have constituted a distinct profession. The observation of the motion of suspended magical stones and, more important, of beads laid on cloth or held between thumb and forefinger was resorted to in the foretelling of death, the diagnosis of disease, the finding of lost and stolen objects, and the discovery of the identity of a witch or conjuror responsible for magically caused disease, to mention but a few of the more important uses of these divination devices. Different formalized procedures were resorted to for different purposes, and in some cases even bits of roots or twigs were employed instead of beads.

were held and no person was allowed to sleep. The proper formulas were recited by the conjuror, and further divination by the beads was tried, until it was found that the person would live. Then that person's life was believed to be secure until the next year.

Will West Long's brother, who died in 1904, was a leader at these ceremonies. Once when he examined a girl with the beads under such circumstances, he found that she would not live until the following summer. He attempted to arrange the feast to prolong her life until the next year, but her family would not cooperate by providing a feast and helping with the ceremony. Therefore it could not be held, and the girl did die the following winter.

It is probably this secondary phase of the ceremony that has survived as a curative feature in association with certain forms of diagnoses and therapy. When we consider that, among the central features of the Green Corn Festivals of the Cherokee and Creek as recorded by the earlier observers, the expiation of crime and the beginning anew of all phases of tribal life attracted much attention, the curative features of these ceremonies may also have been of great significance in aboriginal times.

One early account of the Cherokee Green Corn Festival is contained in an article dictated by Charles Hicks, second chief of the Cherokee Nation,[10] in 1818 and printed in the *Raleigh Register*:[11]

> Before eating the green corn when in the milk, the people collect in the different towns and villages at night, and when the ——— ("not understood in Mr. Hicks' original") comes, the conjuror takes some of the grains of seven ears of corn and feeds the fire, i.e. burns them. After this each family is allowed to cook and eat their roasting-ears, but not before they drink a tea of wild horehound. In like manner they observe the same custom before eating the bean when it fills in the hull.
>
> The green corn dance, so called, has been highly esteemed formerly. This is held when the corn is getting hard, and last four days, and when the national council sits—a quantity of venison being procured to supply the dance. It is said that a person was formerly chosen to speak to the people on each day in a language that is partly lost—at least there is very little of it known now. At such times as the above, a piece of land is laid off and persons appointed to occupy it—no others being allowed to use it while the feast continues.

At present, besides the curative Green Corn Feast, which is performed when required, the Cherokee have also preserved one other fragment of extreme importance. This is the Green Corn Medicine, called both sɛ·lu′ djuwa'nigę′·i da·nisdi′gisgą′n'i ("corn soft, for they are eating") and sɛ·lu′ it'sehi′danisdi′gi·sgą′n'i ("corn, new or green, for they are eating"). Mooney's data on the 1913 observance, already quoted, would indicate that other features had survived as a part of the family ceremony until at least that date.

This Green Corn Medicine, according to tradition, was a feature of the Green Corn Festival, and is probably represented in Hicks's account by the reference to "wild horehound." It is now no longer preceded by a purge, however, and is made and administered by the head of each household to his family; it is an individual, not a community, function, and is performed whenever the family's green corn is ready to eat. According to Mollie Sequoyah, of the Big Cove, it is intended to prevent colic caused by eating corn, the primary food resource of the Cherokee, and one which is much relished. The people have been unaccustomed to eating green corn since the previous year, and its latency for harm or benefit is believed to be strong. Children especially require prophylactic treatment to avert sickness resulting from the first seasonal use of corn. Will West Long states that it is intended to prevent the increase of stomach and intestinal worms, which otherwise would flourish on this choice food and do great damage to the person so rash as to eat of it without the medicinal preparative. None of the really conservative Indians of the Big Cove settlement would even taste green corn if they had not previously partaken of the medicine. I have seen Will look

[10] DRAKE, SAMUEL, *Book of the Indians*, ed. 8, 4: 55. Boston, 1841.

[11] Hicks's account is taken from a clipping preserved in the Bureau of American Ethnology Scrapbook 1: 354, entitled *Manner, customs, etc., of the Cherokee Indians*. Some of this account will also appear in the manuscript by Dr. F. G. Speck previously referred to, and I am indebted to him for the use of his copy of the Hicks article.

PLANTS USED IN GREEN CORN MEDICINE

Indian name	*Translation*	*English name*	*Latin name*
sɛ·lu'kwo·ya'[12]	"Resembling corn"	Bearded wheat grass	*Apropyron caninum* (L.) R. & S.
		Adam's-needle	*Yucca filamentosa* L.[13]
to^{le}ti yusti'	"Sticks on you, like"	Spiny amaranth	*Amaranthus spinosus* L.
ɑwosɑ· ulh^{s}i' yenehi'	"Itself splitting or growing leaves"	Volunteer corn[14]	*Zea mays* L.
unighis'o gohɑst'i'		Wild lettuce	*Lactuca canadensis* L.
walelu' unig'' legisti'	"Hummingbird, taking sap out of flower"	Jewelweed	*Impatens biflora* Walt.[15]
gelu^{t}na'		Gourd[16]	*Cucurbita lagenaria* L.
wat'ska'		Green amaranth	*Amaranthus retroflexus* L.
ᵾgwas'ta' lu^{ya}dɑ'		Ragweed	*Ambrosia trifida* L.
unistelę^{ve} sti'[17]	"Sticking on"	Wild comfrey	*Cynoglossum virginianum* L.
nistele'histi'	"Sticking out"	Ragweed	*Ambrosia elatior* L.

wistfully at "roasting ears" on the table of a neighbor with whom he was dining but refuse the corn because his was not ready yet and he had not taken the medicine. Under similar circumstances, Mollie decided that she could eat the corn only because it was not a variety grown by the Indians, but "white man's corn," and so did not require this preventative measure.

The medicine itself is made up, we know, of the leaves of at least four different plants and sometimes of more. Apparently the recipe varies somewhat from family to family, but I do not have sufficient data to indicate how great the differences may be. These leaves are crushed in the hands and pounded together in the mortar used to crush corn into meal and are then steeped in warm water and the solution drunk by all the members of the family. Then they are free to eat the unripe corn for the remainder of the season.

Herewith is a list of the plant ingredients used by Will West Long. The use of the first three plants is obligatory, and any one of the remainder may be used as the fourth ingredient, the others being added if available. Will West Long explains that these plants are all rampant cornfield weeds and are thus, he supposes, able to overcome the generative power of the corn imparted to the worms, except for the volunteer corn and the plant "resembling corn," which are used because they appear to be dwarfed and weakly plants of the same sort as corn. Any other cornfield weed leaves may be added to the medicine if the preparator so desires. A vermifuge, such as *Artemisia*, might be as good, the informant suggests, but is not used in this association.

The medicine as prepared by Mollie Sequoyah consists of the leaves of four plants, used in exactly the same fashion. This medicine is required to prevent colic, which would plague anyone eating the new green corn without previously taking the medicine. It is especially necessary for children. The ingredients are as follows:

[12] This name is used for both of the plants here listed, and either may be used in this medicine.

[13] According to Will West Long, the roots and leaves of the *Yucca* are also soaked in warm water and the potion drunk as a medicine for "sugar diabetes."

[14] This is merely corn that has seeded itself in a pasture or fallow field.

[15] Leaves and flowers of this plant are also used, according to Mollie Sequoyah, as one ingredient in a tea that is given to a woman in childbirth to "make the child come quickly"; it is so used because of the explosive way in which the seeds fly out of their pods.

[16] According to Mollie Sequoyah, gourd seeds are mashed and soaked in hot water, and the potion is drunk to cure inability to urinate. This is probably related to the white peoples' use of pumpkin seed for the same purpose. (See LEVINE, HAROLD D., *Folk medicine in New Hampshire.* Reprint from New England Journ. Med. **224**: 487–492: 11, 14. 1941.)

[17] This name is the general Cherokee term for bur-bearing plants, but the plant specimen was collected with the informant (as also in other cases). This plant is used as one ingredient in several compound medicines recorded by MOONEY and OLBRECHTS, *The Swimmer manuscript:* 119, 174.

Galų^{t}na′	Gourd
Sɛ·lu kwoyα′	Bearded wheat grass
Walelú unig^{w}ł egisti′	Jewelweed
u·wαgα′	Volunteer corn

There are several observances in force concerning the eating of the unripe corn. The corn is the gift of a culture heroine, whose name is sɛ·lu, the same name as that applied to corn, and the corn came from her body. These rules for treatment of the green corn and their explanation, as offered by Mollie Sequoyah, have their basis in the myth of the origin of corn, as do some of the features of the Green Corn Festival. Two versions of the story of the Corn Mother are represented later in this paper.

One must not blow on a roasted ear of green corn in order to cool it, as this would cause a thunderstorm. The Thunders are the sons and husband of Sɛlu, the Corn Mother, and would resent such disrespectful treatment of her. After the green corn has been eaten, the cobs must be kept in the house for four days, because Sɛlu's body lay outdoors on the ground for that length of time after she had been killed by her son. The all-night dancing and wakefu ness of the Green Corn Festival are the observation of the original admonition that they should stay awake all night and dance, so that the corn would grow and mature overnight.

The story of the origin of Corn, as told by Mollie Sequoyah, differs in some important features from the published accounts and from versions I have collected from other parts of the reservation.[18] Collection of further variants from existing groups of Cherokee both in North Carolina and Tennessee and in Oklahoma, and comparative study of these myths, might throw further light on Cherokee economic and ceremonial practices involving corn, besides making a contribution to the comparative study of a major myth distributed from the Creek Indians of the Southeast to the Malecite of Nova Scotia.[19]

[18] The principal versions of the Sɛlu tale are recorded in the following sources all by JAMES MOONEY: *Myths of the Cherokees.* Journ. Amer. Folklore **1**: 98. 1888; *Cherokee and Iroquois parallels.* Journ. Amer. Folklore **2**: 67. 1889; *Myths of the Cherokee.* 19th Ann. Rep. Bur. Amer. Ethnol. 242–245, 248, 431–434. 1889.

MOLLIE SEQUOYAH'S VERSION

Once a man and wife lived by themselves, with their little boy. As the boy grew older, he noticed that, while his father went hunting, his mother always went into a little storehouse (called na^{w}wedolα′, an archaic term, in this story) where she obtained corn, beans, and similar vegetables for her family. When he was older, he began to wonder how she managed this, because she was always bringing food from the storehouse, but never carried anything into it.

One day he hid by the storehouse and watched her through a crack in the wall when she entered. He saw her shake herself and beat her body with her hands, and corn and beans came spilling out onto the floor from beneath her dress. Her son thought, "Why that stuff is only excrement, and she makes us believe it's food." When his mother came out of the storehouse, he killed her. In anger, he dragged her body all over the stump-filled clearing and then threw her body on the ground next to the branch (small mountain stream, the general Cherokee water supply). He chopped off her head and set it up in the window of the house, where the father would see it when he returned.

When the father returned after four days, he was very angry with his son. They went to the branch in order to bury Sɛlu's body. There they found a little boy playing in the grass. He had been born from the blood flowing from Sɛlu's severed neck. They took him back, and he grew up to become the younger Thunder brother. When they returned to the cabin, they could see the blades of the first corn growing among the stumps in the clearing where her body had been dragged. The father said that they must stay awake all night, singing and dancing to keep themselves from falling asleep. They did this, and the corn was full

[19] Some of the non-Cherokee sources are as follows: SWANTON, JOHN R., *Myths and tales of the Southeastern Indian.* Bur. Amer. Ethnol. Bull. **88**: 9–17 (Creek), 230–234 (Natchez). 1929; MORGAN, LEWIS H., *League of the Iroquois* 161, 162, 199. Rochester, 1851; MECHLING, W. H., *Malecite tales.* Can. Dept. Mines, Geol. Surv. Mem. **49**: 87. Ottawa, 1914; SPECK, F. G., *Penobscot tales and religious beliefs.* Journ. Amer. Folklore **48**: 75. 1935.

grown and ripe by sunrise. In the beginning the corn could be planted in the evening and gathered ripe in the morning. Later, when the people became careless, they fell asleep one night while the corn was growing, and ever since corn has required a much longer growing season. This occurred when the father and sons were traveling west, in order to take up their station as the Thunders.

MOSES OWL'S VERSION

Moses Owl tells a somewhat different version of the story:

A couple lived in the woods with their only child. After awhile they found that he was playing with another little boy. They conspired to catch this little boy, and had their son lead him into a big trap with a door that was propped in place. The son dropped the door, imprisoning them both.

This little boy, who had been born of the blood of the game that his mother washed in the branch, was very wild and fought for his freedom, but eventually he was tamed and taught to talk and was raised as the twin brother of their son.

The tame boy was well-behaved, but his wild brother was contrary-minded and was always getting himself into trouble, and leading his companion into mischief. Finally, when they were almost grown, the mischievous brother suggested that they follow their father when he went hunting. They saw him remove a stone from the mouth of a cave, enter, and return with a deer on his back. He kept all the game that was in existence in this cave. After he had left, the boys removed the stone, but they did not know the proper charms for controlling these animals, so they all escaped. Ever since, the game has been free in the woods, instead of being the monopoly of one person, so that now everyone has the same right to the animal resources, but they have to search and work for what they get from the hunt. When the father saw the game loose in the woods, he knew what had happened, so he met the boys on the road, gave them a severe beating, and sent them on home to their mother. When they came to the house, they sneaked up and peered through a crack in the logs, because they were afraid she would give them a beating too. There they saw Sɛlu standing over a basket, shaking herself, and the corn pouring from beneath her skirts into the basket.

The wild boy said she was a witch. He ran to the door and killed Sɛlu with an arrow. His brother ran after him, angry and intending to kill him, but the wild boy threw Sɛlu's body over his shoulder and ran off. The brother pursued him until he had to drop the body in order to escape. In each of his footprints a cornplant had sprung up, and an ear of ripe corn lay where he had dropped Sɛlu. Ever since the people have planted and cared for the corn, and gathered Sɛlu's bright gift each autumn.

The sketch of the Green Corn Festival and of its background and derivatives, which is here presented, gives us an idea of the specific evolution of one element in Cherokee culture for a period of over a century. It appears that disintegrative influences were already active against this ceremonial observance and later, after the Removal (1838), the few communities of the Cherokee left in North Carolina were exposed to much stronger acculturative forces. It is interesting to note the gradual breakup of this most important ceremonial complex and, at the same time, the tenacity with which the more conservative families retained, and perhaps modified, important parts of the ritual series.

Dr. Leonard Bloom, in a recent article,[20] has attempted to discover indices of Cherokee conservatism by a correlation of the data he has collected on Indian blood percentage, clan affiliation, linguistic habit, and crafts. Without discussing his data here, we may suggest that cultural factors used in such a correlation should be not crafts, which are subject to economic motivation, but rather factors that have little or no economic survival value. Such nonmaterial traits as the use of Sequoya's syllabary in writing and the use of the Green Corn Medicine would permit a better determination of the relationship of blood to linguistic habit and other cultural traits, in terms probably of households rather than individuals. Such correlations of a number of nonmaterial traits would show degrees of conservatism, with probably only a very conservative nucleus of a few "full-blood"

[20] BLOOM, LEONARD, *A measure of conservatism.* Amer. Anthrop. 47: 630–635. 1945.

families still preserving some use of the Green Corn Medicine.

From the collection of data here presented it appears that the Cherokee in aboriginal times celebrated a major community festival when the green corn first became mature enough to eat; this festival persisted, probably in an abbreviated form as late as 1887. Portions of this ritual became separated from the obsolescent Green Corn Festival and at present are found as two separate survivals, a Green Corn Feast held for curative purposes whenever it may be required and a Green Corn Medicine, which is prepared in the separate households of the more conservative Cherokee and administered to all members of the family as a prerequisite to eating the green corn. Continued adherence to this medicine ritual indicates the strong conservatism of a certain minority of "full-blood" Cherokee households.

BOTANY.—*Mosses of El Salvador.*[1] WILLIAM C. STEERE, University of Michigan, and DOROTHY E. CHAPMAN, Office of Foreign Agricultural Relations. (Communicated by E. H. WALKER.)

The moss flora of one Central American republic, El Salvador, has remained almost completely unknown up to the present time, even though the mosses of neighboring countries have been rather extensively collected and studied. Our knowledge of the mosses of El Salvador has been confined until now to a list of 11 species included in a catalogue of the plants of the republic.[2] These 11 species are *Erythrodontium squarrosum, Fabronia flavinervis, Funaria calvescens, Orthostichidium excavatum, Pilotrichella viridis, Porotrichum cobanense, Leptodontium sulphureum, Mittenothamnium diminutivum, Papillaria nigrescens, Pireella pohli,* and *Polytrichum angustifolium,* of which only the first six are duplicated in the collections of Chapman and Kovar reported upon here. The fact that these recent larger collections have not duplicated completely all species of earlier collections demonstrates conclusively the need for further bryological explorations in El Salvador, especially since many species common elsewhere in Central America are not represented in these collections. El Salvador is so nearly a blank on the bryological map that it is necessary to report as new to its flora such common and widely distributed mosses as *Fissidens kegelianus, Trematodon longicollis, Octoblepharum albidum, Anoectangium euchloron, Bryum argenteum, Pohlia cruegeri, Philonotis glaucescens, P. gracillima,* and *Sematophyllum caespitosum.* One may still wonder why several other ubiquitous species as *Macromitrium mucronifolium, Taxithelium planum, Hyophila tortula, Rhacopilum tomentosum, Neckeropsis disticha,* and *N. undulata* have apparently still not been collected in El Salvador.

As a consequence of the lack of information concerning the mosses of El Salvador, it seems thoroughly worth while to give rather full data pertaining to the stations from which the present collections came. The following geographical and geological data on the collecting stations are based on information furnished by Dr. Anton Kovar, botanist at the Centro Agrónomo de El Salvador:

COLLECTING STATIONS OF DOROTHY E. CHAPMAN

Station A. La Ceiba, 6 km west of San Salvador, is at an altitude of 2,279 feet above sea level. It is near the upper limit of the Lower Arid Tropical Zone, where the temperature and relative humidity are comparatively high and uniform throughout the entire year, regardless of the season. The mean annual humidity is 75 percent, dropping in the dry season to ±70 percent and rising in the rainy season to 87 percent. The mean annual temperature is 74°F., with a maximum of about 90°F. and a minimum of 60°F. A year's average rainfall, based on recordings taken over a 12-year period, is ±64 inches. The soil is well-drained

[1] Contribution from the Department of Botany and the Herbarium of the University of Michigan. Received April 11, 1946.

[2] Standley, P. C., y S. Calderón. *Lista preliminar de las plantas de El Salvador* (Musci, pp. 18–19). San Salvador, 1925; ed. 2, 1941.

volcanic pumice. The mosses were collected on July 25, 1945, along the edges of the driveways and flower beds of the Experimental Station on otherwise bare soil, except for a few growing on living trees.

Station B. Santa Tecla, 12 km west of San Salvador, is at an altitude of 2,842 feet. It is near the lower limit of the Upper Arid Tropical Zone. Because of its peculiar location between the San Salvador Volcano and the Pacific coastal mountain range, this site is more humid than are other parts of the same zone, and it rains here more than in many other sections of the country. The maximum temperature averages 75–80°F., with a minimum of ±45°F. The mosses were collected on July 24, 1945, along the driveways, roads, and fields of the Centro Agrónomo de El Salvador and its immediate vicinity. The soil here consists of a top black soil layer of variable thickness, with volcanic ash beneath it, and underlying these a thin layer of talpetate (cemented and impermeable volcanic ash); then old lava flows underneath all.

Station C. The rim of the crater of the San Salvador Volcano is at an altitude of 6,132 feet. Although it is still in the Upper Arid Tropical Zone, a high degree of humidity is present in the form of dew carried by the winds from the Caribbean coast. Even during the driest season of the year, the soil and vegetation are often covered with droplets of condensed water vapor. No specific data are available as to the rainfall, relative humidity, or temperature. The soil is talpetate. The mosses were collected July 28, 1945, along the path on the crater rim among heavy herbaceous growth.

Station D. The automobile road from Santa Tecla, up the San Salvador Volcano at an altitude of 4,225 feet, is in the middle of the Upper Arid Tropical Zone. No data are available on the humidity and temperature, although both are probably lower than at Santa Tecla. However, at this particular site a mist often occurs, even at the beginning of the dry season. The soil is composed of volcanic ashes. The mosses were collected on July 28, 1945, along the steeply cut banks of the road on soil and on tree trunks.

COLLECTING STATIONS OF DR. ANTON KOVAR

The three localities, El Pilón de los Naranjos, El Jardín, and Cerro del Manzano, are in the western part of El Salvador. The west of El Salvador is in general somewhat higher than the east, and there is more of the original vegetation left. No rainfall data are available, but it can be said that the average annual rainfall is somewhat higher than in San Salvador. In San Salvador it is about 71 inches; in the region where these specimens were collected, especially at the higher altitudes, it is not below 80 inches. No temperature data are available. Judging from similar situations on the volcano of San Salvador and from personal observations, Dr. Kovar estimates that the temperature varies from 5 C. as a minimum to 25°C. as a maximum. The soils are of volcanic origin, and more or less disintegrated, especially at El Jardín and El Manzano. El Cerro del Pilón seems of more recent origin, although it is decidedly older than the volcano of San Salvador.

Cerro del Manzano (January 14, 1946). The site is at about 5,200 feet altitude. The forest shows clear signs of transition between the Upper Dry Tropical Zone and the Humid Upper Tropical Zone (cloud forest). The locality has a northern exposure.

El Jardín (December 27, 1945; January 15, 1946). At 6,500 feet altitude, this station lies wholly within the Upper Humid Tropical Zone. It is a ridge about a mile and a half long running from west to east. The locality is on the northern slope.

El Cerro del Pilón (January 16, 1946). At an altitude of 6,500 feet and south of El Jardín, which protects it against the humid northern winds from the Atlantic coast. The vegetation is decidedly xerophytic. There is a marked difference between the northern and southern slopes of the central volcanic chain. Although this chain is much nearer to the Pacific Ocean, given the prevailing northern winds the northern slopes from 5,000 feet and up receive more moisture than the southern slopes. Therefore the northern slope has a cloud forest whereas the southern slope at the same altitude has xerophytic vegetation. Yet as one goes from west to east the Humid Upper Tropical Zone is less marked. While it is very noticeable on the volcano of Santa Ana, it is somewhat less so on the volcano of San Salvador. On the volcano of San Vicente it can be noticed only on a small area near the top. San Miguel Volcano does not show it at all; probably the mountain chains in Honduras stop all the moisture.

In El Salvador the rainy season in all zones starts during the month of May and ends the latter part of October. During this period storms may be of great violence with an extremely heavy rainfall. Throughout the dry season, which lasts from November to April, there are occasional rains, usually in early November and early January.

In the following list it is interesting to note that the mosses from the Upper and Lower Arid Tropical Zones, such as *Aloinella catenula, Barbula bescherellei,* and *Globulina globifera,* are most closely related to those of dry uplands in Mexico and Guatemala, whereas the mosses from the cloud forests of the Humid Upper Tropical Zone, as *Rigodium gracile, Atrichum oerstedianum,* and *Squamidium leucotrichum,* are most closely related floristically to those of Costa Rica, the West Indies, and northern South America.

FISSIDENTACEAE

Fissidens kegelianus C. Müll. On soil, La Ceiba, *Chapman A-6;* on soil, Santa Tecla, *Chapman B-21.*

Distribution: Not uncommon at lower altitudes throughout tropical America.

Fissidens repandus Wils. ex Mitt. On soil, Santa Tecla, *Chapman B-19;* on soil, summit of Volcan San Salvador, *Chapman C-2;* on soil, road up Volcano San Salvador from Santa Tecla, *Chapman D-3;* on soil, El Jardín, December 27, 1945, *Kovar 6a.*

Distribution: Florida; Mexico; West Indies; northern South America. The type locality is near Quito, Ecuador, and not Mexico, as stated by Grout (North American Flora **15**: 176. 1943).

Fissidens vardei Thér. On rotten wood, Cerro del Manzano, *Kovar 18a.*

Distribution: Greater Antilles; Guatemala.

DITRICHACEAE

Trematodon longicollis Michx. On soil, Cerro del Manzano, *Kovar 9, 14b, 17b.*

Distribution: Cosmopolitan throughout the warmer climates of the world.

DICRANACEAE

Campylopus filifolius (Hornsch.) Mitt. El Jardín, December 27, 1945, *Kovar 3.*

Distribution: Central America; Brazil.

LEUCOBRYACEAE

Octoblepharum albidum Hedw. On bamboo roots, Montserrate, near La Ceiba, 800 meters alt., January 11, 1946, *Kovar 8.*

Distribution: Throughout tropical and subtropical climates of the whole world.

POTTIACEAE

Aloinella catenula Card. On soil, Santa Tecla, *Chapman B-7.*

Distribution: Mexico; Guatemala.

Anoectangium euchloron (Schwaegr.) Mitt. On earth, Santa Tecla, *Chapman B-12;* Cerro del Manzano, *Kovar 15.*

Distribution: Southern United States; throughout tropical and subtropical America; Asia.

Barbula bescherellei Sauerb. On soil, Santa Tecla, *Chapman B-17;* summit of Volcano San Salvador, *Chapman C-6;* road up Volcano San Salvador from Santa Tecla, *Chapman D-1.*

Distribution: Southern United States; Mexico; Guatemala.

Globulinella Steere gen. nov. (*Globulina* C. Müll., 1897, nec *Globulina* Spegaz., 1889).

Globulinella globifera (Hampe) Steere n. comb. (*Seligeria globifera* Hampe, Bot. Zeit. **28**: 49. 1870; *Trichostomum obtusifolium* Hampe, *ibid.* **28**: 49. 1870; *Globulina globifera* C. Müll., Nuov. Giorn. Bot. Ital. n.s. **4**: 39. 1897, Broth. in E. & P., Nat. Pflanzenfam. 1(3): 404. 1902; *Gyroweisia obtusifolia* Broth., *ibid.* 1(3): 389. 1902.) On soil, Santa Tecla, *Chapman B-4.*

Distribution: Mexico; Honduras.

Globulinella globifera, based on *Seligeria globifera* Hampe, is a clear-cut, unmistakable species that has been collected only a few times since its original discovery. Immediately preceding the description of *S. globifera* is the diagnosis of another proposed new species, *Trichostomum obtusifolium* Hampe, which was later transferred to *Gyroweisia* by Brotherus (1902). In reading the original descriptions of these two new species, which grew intermixed in the same type collection, one cannot help being impressed by their great similarity. Parallel phrases from the original descriptions are compared below:

Trichostomum obtusifolium	*Seligeria globifera*
"Dioicum, . . . saturate viride, gregarie.	"Dioica?, . . . gregaria, lutescente viridis, infra fuscata.
Caulis brevissimus paucifolius	Caulis brevissimus erectus, conglobatus.
Folia margine erecto concava, inferiora minora, obtuse ovata, . . . sicca involuto-conglobata, integerrima humida subcucullato-concava. . . .	Folia in globulos convoluta, ovalia, subcucullato-concava, obtusissima, integerrima . . .
Nervo lutescente apice evanido	. . . Nervo crasso lutescente apice abrupto
Cellulis basilaribus subquadratis hyalinis, caeteris dense aggregatis minimis granulosis, griseo-viridi opacis.	Cellulis basilaribus subquadratis laevioribus, pellucidis, in superiori parte folii dense aggregatis, minoribus, lucide granulatis.
Folium perichaetiale unicum convolutum.	(Folia) perichaetialia convoluta, longiora, erecta
Seta gracillima erecta (4–6''') e flavo demum rubens	Seta gracillima 4–6 linearis flavide rubens
Theca erecta angusta, parce oblique elliptico-cylindrica	Theca oblongo-cylindrica, annulata
Peristomium annulo hyalino circumdatum, intense rubrum, dentibus profunde bifidis, cruribus subulatis rugulosis	Peristomii dentibus brevibus subulatis, torulosis rubris.
Operculo brevi conico-rostrato Calyptra angusta fuscata"	Operculo conico-subulato Calyptra angusta, demum fuscata"

An analysis of the above comparison shows more similarities than differences. The only serious distinction between the two species seems to be in peristome structure, since it is implied that the *Seligeria* has 16 undivided teeth, an important generic character. However, Brotherus (1902, fig. 260) illustrated and described *Globulina globifera* with the teeth divided in the manner of many genera of the Pottiaceae, undoubtedly on the basis of authentic material. Hampe, himself, in comparing the two species, offers the following note concerning his *Seligeria globifera:* "Ex habitu *Trichostomi obtusifolii,* cum eo commixtum lecta; colore lutescente viridi aliena, inter Seligerias ob thecam cylindricam singularis." Most mosses differ to some extent in color between new and old growth, and this color difference is especially conspicuous in the Pottiaceae, where the new leaves are usually a bright yellowish or bluish green and the old leaves a dark green, red, or brown to black. It is probable that the specimen seen by Hampe contained plants of several seasons, showing the color differences he stresses. Furthermore, several Mexican specimens named *Gyroweisia obtusifolia* by Cardot and Thériot are clearly *Globulina globifera.* For additional evidence of the close relationship of these two species, the opinion of Andrews[3] may be cited. In speaking of the genus *Gyroweisia,* he says: "*G. obtusifolia* (Hpe.) Broth. from Mexico is a plant in many ways suggesting relationship with the Mexican species of the genus *Globulina* C. M." Another similar opinion is that of Müller,[4] who says: "Das niedliche Pflänzchen, welches diesen Typus begründet, nämlich Seligeria globifera Hpe., welche Strebel in den 60er Jahren an Kalkfelsen bei Veracruz in Mexico sammelte, hat ganz die Tracht eines kleinen Trichostomum, etwa des T. obtusifolium Hpe., mit welchem es zusammen wächst."

Consequently, there seems to be no valid excuse for keeping separate Hampe's two species based on one type collection, and it is therefore proposed to put the less well known *Trichostomum obtusifolium* into the synonymy of *Seligeria globifera,* although the strictest interpretation of priority of place might indicate the opposite procedure.

Since *Globulina boliviana* has been transferred to *Barbula* by Hilpert,[5] after a careful study, the only other species which belongs here is *Globulinella peruviana* (R. S. Williams) Steere n. comb. (*Globulina peruviana* R. S. Williams, Bull. Torrey Bot. Club **43**: 325. *pl. 17, f. 8–15.* 1916).

Rhamphidium macrostegium (Sull.) Mitt. On rock, Cerro del Pilón, *Kovar 28a.*

Distribution: West Indies; Mexico, Costa Rica; South America.

[3] Andrews, A. L. *The status of* Gyroweisia *in North America.* Bryol. **25**: 97–100. 1922.

[4] Müller, C. *Genera muscorum frondosorum,* vi+474 pp. Leipzig, 1901.

[5] Hilpert, F. *Studien zur Systematik der Trichostomaceen.* Bot. Centralbl. **50**(2): 585–706. 1933.

Tortula caroliniana Andrews. On tree, summit of Volcano San Salvador, around crater, *Chapman C-4.*

Distribution: Southern United States; Mexico; Guatemala, Costa Rica.

FUNARIACEAE

Funaria calvescens Schwaegr. On soil, La Ceiba, *Chapman A-2;* on soil, Santa Tecla, *Chapman B-1;* on soil, road up Volcano San Salvador from Santa Tecla, *Chapman D-6;* Cerro del Manzano, *Kovar 14, 17.*

Distribution: El Salvador; throughout all tropical and subtropical regions of the world.

SPLACHNACEAE

Splachnobryum bernoullii C. Müll. On soil, La Ceiba, *Chapman A-1;* on soil, Santa Tecla, *Chapman B-5.*

Distribution: Guatemala, Honduras; Mexico.

BRYACEAE

Anomobryum semiovatum (Brid.) Jaeg. On soil, Santa Tecla, *Chapman B-6.*

Distribution: Costa Rica; South America.

Brachymenium capillare Schimp. On soil, summit of Volcano San Salvador, *Chapman C-5* (a juvenile state).

Distribution: Mexico; Costa Rica.

Bryum andicola Hook. On roots, summit of Volcano San Salvador, around crater, *Chapman C-3;* on rotten wood, El Jardín, December 27, 1945, *Kovar 5a,* on humus, *Kovar 6.*

Distribution: Mexico; Honduras, Costa Rica; West Indies; South America.

Bryum argenteum Hedw. On soil, La Ceiba, *Chapman A-4;* on soil, Santa Tecla, *Chapman B-2;* on soil, summit of Volcano San Salvador, around crater, *Chapman C-1* (var. *lanatum*); on soil, road up Volcano San Salvador from Santa Tecla, *Chapman D-5;* Cerro del Manzano, *Kovar 9a, 14a, 17a.*

Distribution: A weedy species truly cosmopolitan in all parts of the world.

Epipterygium immarginatum Mitt. On soil, Santa Tecla, *Chapman B-3.*

Distribution: Guatemala.

Pohlia Cruegeri (Hampe) Andrews. On earth, Santa Tecla, *Chapman B-8.*

Distribution: Southern United States; widespread in tropical America.

Pohlia papillosa (C. Müll.) Steere n. comb. (*Bryum papillosum* C. Müll., Syn. **1**: 326. 1849.) On soil, Cerro del Pilón, *Kovar 28.*

Distribution: West Indies; Costa Rica; northern South America.

BARTRAMIACEAE

Philonotis glaucescens (Hornsch.) Paris. On soil, Santa Tecla, *Chapman B-16.*

Distribution: Southern United States; widespread in tropical America.

Philonotis gracillima Aongstr. On soil, La Ceiba, *Chapman A-3;* on earth, Santa Tecla, *Chapman B-15.*

Distribution: Widespread in tropical and subtropical America, usually at lower altitudes.

Philonotis sphaericarpa (Hedw.) Brid. On soil, summit of Volcano San Salvador, around crater, *Chapman C-7.*

Distribution: Florida; West Indies; Mexico; Central and South America; usually at higher altitudes.

PRIONODONTACEAE

Prionodon densus (Hedw.) C. Müll. On tree, El Jardín, December 27, 1945, *Kovar 4a;* January 15, 1946, *Kovar 20;* on tree, Cerro del Pilón, *Kovar 31.*

Distribution: West Indies; Mexico; Central and South America.

PTEROBRYACEAE

Orthostichidium pentagonum (Hampe) C. Müll. On tree, Cerro del Pilón, *Kovar 30.*

Distribution: Mexico; British Honduras, Costa Rica; South America. The report of *Orthostichidium excavatum* from Cerro del Guayabal, El Salvador, by Standley and Calderón should undoubtedly be referred here.

METEORIACEAE

Meteoriopsis patula (Hedw.) Broth. On branch, Cerro del Manzano, *Kovar 11;* epiphytic, El Jardín, January 15, 1946, *Kovar 23.*

Distribution: Very widespread in tropical and subtropical America.

Pilotrichella flexilis (Hedw.) Jaeg. Epiphytic, El Jardín, January 15, 1946, *Kovar 19;* epiphytic, Cerro del Pilón, *Kovar 29.*

Distribution: West Indies; Mexico; Central and South America.

Pilotrichella rigida (C. Müll.) Besch. Epiphytic, Cerro del Pilón, *Kovar 35.*

Distribution: Mexico; Guatemala, Costá Rica; Honduras. The report of *Pilotrichella viridis* from Ahuachapán, El Salvador, by Standley and Calderón, almost certainly refers to this species.

Squamidium leucotrichum (Tayl.) Broth. On twig of cypress, Cerro del Manzano, *Kovar 11a;* on small branch, El Jardín, January 15, 1946, *Kovar 22.*

Distribution: West Indies; Costa Rica; South America.

PHYLLOGONIACEAE

Phyllogonium fulgens (Hedw.) Brid. On tree, El Jardín, December 27, 1945, *Kovar 4.*

Distribution: West Indies; Central and South America.

NECKERACEAE

Homalia glabella (Hedw.) Mitt. On rock, Cerro del Pilón, *Kovar 33.*

Distribution: West Indies; Mexico; British Honduras, Honduras, Costa Rica; northern South America.

Neckera urnigera C. Müll. On tree, Cerro del Pilón, *Kovar 30a.*

Distribution: Mexico.

Porotrichum cobanense C. Müll. On rock, El Jardín, December 27, 1945, *Kovar 2a;* on tree, Cerro del Manzano, *Kovar 10, 18b;* on rock, Cerro del Pilón, *Kovar 26;* epiphytic, *Kovar 37;* on rock, *Kovar 38.*

Distribution: El Salvador, Guatemala, British Honduras, Costa Rica, Panama.

LEMBOPHYLLACEAE

Rigodium gracile Ren. & Card. Epiphytic, Cerro del Pilón, *Kovar 34a.*

Distribution: Costa Rica.

HOOKERIACEAE

Lepidopilum haplociliatum (C. Müll.) Paris. On twig, El Jardín, December 27, 1945, *Kovar 1.*

Distribution: Guatemala, Costa Rica.

FABRONIACEAE

Fabronia flavinervis C. Müll. On wood, La Ceiba, *Chapman A-5;* on tree, Santa Tecla, *Chapman B-10;* on roadside tree, road up Volcano San Salvador from Santa Tecla, *Chapman D-7.*

Distribution: El Salvador, Guatemala, Honduras, Costa Rica; Mexico.

BRACHYTHECIACEAE

Brachythecium stereopoma Spruce. On soil, summit of Volcano San Salvador, around crater, *Chapman C-9.*

Distribution: West Indies; Costa Rica; South America.

ENTODONTACEAE

Erythrodontium densum (Hook.) Paris. On wood, Santa Tecla, *Chapman B-11.*

Distribution: Mexico; Costa Rica; South America.

Erythrodontium squarrosum (C. Müll.) Paris. On tree, Santa Tecla, *Chapman B-9;* on tree, road up Volcano San Salvador from Santa Tecla, *Chapman D-2.*

Distribution: El Salvador, Costa Rica; South America.

PLAGIOTHECIACEAE

Stereophyllum mexicanum R. S. Williams. On wood, Santa Tecla, *Chapman B-14.*

Distribution: Mexico.

SEMATOPHYLLACEAE

Sematophyllum caespitosum (Hedw.) Mitt. On wood, Santa Tecla, *Chapman B-13;* on twig, El Jardín, December 27, 1945, *Kovar 2.*

Distribution: Widely distributed through the tropics and subtropics of the whole world.

HYPNACEAE

Microthamnium lehmanii Besch. On dead wood, Cerro del Manzano, *Kovar 12, 18;* epiphytic, Cerro del Pilón, *Kovar 29.*

Distribution: Costa Rica.

Microthamnium reptans (Hedw.) Mitt. On rotten wood, El Jardín, December 27, 1945, *Kovar 5;* epiphytic, Cerro del Pilón, *Kovar 34.*

Distribution: Very widespread in tropical America.

POLYTRICHACEAE

Atrichum oerstedianum (C. Müll.) Mitt. On soil, El Jardín, December 27, 1945, *Kovar 7;* on soil, Cerro del Pilón, *Kovar 36.*

Distribution: Costa Rica, Honduras.

Pogonatum liebmannianum Schimp. On soil, Cerro del Manzano, *Kovar 13*.

Distribution: Mexico; Costa Rica.

Polytrichum juniperinum Hedw. On soil, Cerro del Pilón, *Kovar 25*.

Distribution: In temperate and cold climates of the whole world.

BOTANY.—*A new species of* Sphaceloma *causing scab of plantain* (Plantago).[1]

ANNA E. JENKINS, Bureau of Plant Industry, Soils, and Agricultural Engineering, and A. A. BITANCOURT, Instituto Biologico, São Paulo, Brazil.

In 1938 a specimen of *Sphaceloma* on plantain (*Plantago formosana*), which he had collected at Taihoku, Formosa, on May 16, 1928, was sent to the senior writer by K. Sawada of the Taihoku Imperial University. The specimen showed abundant leaf and peduncle spotting (Fig. 1, I). In 1939, the writers found the same type of spotting on plantain (*P. rugelii*) in Washington, D. C., near the entrance to the Smithsonian Institution Building and on the grounds of the Washington Monument. Subsequently they collected specimens of the same fungus in New Jersey, Michigan, Indiana, and Illinois. The record of the fungus in Indiana previously made (*5*) is based on the collection in Indiana, here illustrated (Fig. 1, A–H and J–M).

These several collections, together with others now available, reveal that this fungus is widespread in eastern United States. It was extremely abundant in the District of Columbia area during the summer and autumn of 1940, when it was isolated in pure culture (Fig. 1, N). Mature inflorescences of the *Plantago* showed that it was *P. rugelii*. Unfortunately, because of the lack of mature inflorescences, it has not been possible among some of the other specimens available to determine whether the host species is *P. rugelii* or *P. major*. Two early specimens examined, hitherto unidentified, are from Still Pond, Md., October 10, 1891, E. F. Smith, and Arlington, Conn., October 27, 1900, G. P. Clinton. In the former case the leaves were collected because of the presence of *Erysiphe cichoracearum* DC. on them, but the *Sphaceloma* (*6*) spot also is abundant. The label of this specimen does not bear the collector's name. The handwriting, however, may be distinguished as that of Dr. Erwin F. Smith, who was studying peach yellows at Still Pond at this time. His bulletin on the subject (*10*) refers to a visit to Still Pond as late as July 24, 1891 (*loc. cit.*, foot note p. 43); that of October 10 doubtless was too late for similar record.

Since this pathological condition and the pathogen have not been accorded recognition as taxonomic entities, the disease is here termed "scab of plantain," and the fungus is proposed as a new species.

Sphaceloma plantaginis, sp. nov.

Spots on leaves and scapes, including bracts and calyx, few to numerous, scattered, although may be more abundant on lower part of leaves and peduncles; on leaves diaphyllous, usually more prominent above, circular to subcircular, minute to 1.5 mm in diameter, coalescent, usually in small groups, often with raised margins, either hyperplastic or necrotic, or hyperplastic in outer area and necrotic in central pale area, necrotic tissue collapsed, often reduced to the imperfectly formed upper and lower epidermis, papery and translucent except for veins, which remain after the other tissue has become lacerated and dropped away; on scapes circular to elliptical, occasionally elongate, on peduncle often depressed, minute 1–1.5, rarely 2 mm in diameter, at first water-soaked in appearance, occasionally "neutral red"[2] usually (on dry specimen) "deep vinaceous" to "russet vinaceous," sometimes "pale grayish vinaceous,"central area or occasionally entire spot paling to dirty white or white; hyphae subcuticular, becoming intraepidermal, disrupting the epidermis, forming a more or less extensive superficial hyaline stroma up to 15μ thick, this sometimes extending below the epidermis, as a loose prosenchyma, or forming a naked hyaline stroma projecting hori-

[1] Received March 22, 1946.

[2] Colors in quotation marks are based on Ridgway (*9*).

zontally from the margin of the perforation, up to 50μ thick; acervuli absent, sparse or abundant, amphigenous, more often epiphyllous, in one case as many as 40 dotting the necrotic center of a leaf spot 0.5 mm in diameter, viewed from above, circular to elliptical, 15μ to 65μ in diameter, may be confluent, hyaline to brown; conidiophores closely grouped, pointed, 8–10 by 2.6–3.3μ, hyaline to colored, in culture as many as 16μ long, produced at right angles to the hyphae, bearing apical and lateral conidia as illustrated by Doidge and Butler (*3*) for what was later identified (*4*) as *Sphaceloma* on citrus; conidia sessile on the hyphae or stroma, as well as pleurogenous on conidiophores, spherical to elliptical or oblong, often bigultulate, usually 5–10 by 2–4μ, swelling and becoming 2-celled and colored.

Maculis foliicolis sparsis, minutis usque 1.5 mm latis, amphigenis, frequenter margine elevata cinctis, parte centrali papyracea hyalina, primo castaneo-rubra et deinceps in medio albicante. Maculis in inflorescentiis, in pedunculis et petiolis, magis elongatis, 1–1.5 mm, raro 2 mm latis, in medio depressis.

Acervulis amphigenis, communiter tantum epiphyllis, punctiformibus, nigris, 15–65μ latis, distinctis vel saepe confluentibus. Conidiophoris arcte connatis, acutis, 8–10 $\times$ 2.6–3.3μ, hyalinis vel obscuris, conidiis sphaericis, ellipticis vel oblongis, frequenter 2—guttulatis, hyalinis, 5–10 $\times$ 2.5μ.[3]

Hosts, distribution, and specimens examined:[4]

ON PLANTAGO SP.

CONNECTICUT: Arlington, Oct. 27, 1900, G. P. Clinton† (Ex. Herb. Dept. Plant Pathology and Botany, Conn. Agr. Exp. Station). MARYLAND: Olney, Sept. 28, 1941, A. E. Jenkins†; vic. Rockville, Aug. 31, 1945, A. E. Jenkins†; Still Pond, Oct. 10, 1891, E. F. Smith†. MASSACHUSETTS: Cambridge, June 1940, L. Grosinsky†; Marshfield, Aug. 8, 1942, O. C. Boyd*; Waltham, June 26, 1941, J. G. Horsfall and A. E. Jenkins. MICHIGAN: East Lansing, Sept. 24, 1939, A. A. Bitancourt and A. E. Jenkins. NEW JERSEY: Bloomfield, Sept. 15, 1939, A. A. Bitancourt and A. E. Jenkins‡; Highland Park, Sept. 20, 1940, P. P. Pirone*. NEW YORK: Walton, July 7, 1942, A. E. Jenkins†. PENNSYLVANIA: Herndon, July 14, 1940, A. E. Jenkins. VERMONT: Plymouth near birthplace of Calvin Coolidge, June 27, 1941, A. E. Jenkins. VIRGINIA: Williamsburg, May 25, 1940, A. E. Jenkins. WEST VIRGINIA: vic. Elkins, Aug. 15, 1944, R. E. Atkinson and P. R. Miller.

ON PLANTAGO FORMOSANA Masam.

FORMOSA, Taihoku, May 16, 1928, K. Sawada. Taihoku is the type locality for *P. formosana*, which was described in 1932 (cf. *8*). From the diagnosis and from Sawada's specimen, it would appear that this species of *Plantago* is more or less closely related to *P. major*. The spotting on the Formosan gathering is minute on leaves; otherwise it resembles infected growth of *P. major* and *P. rugelii* from this country. It seems reasonable for the present at least to regard the *Sphaceloma* on *P. formosana* as *S. plantaginis* as is here done. *P. major* is found in Formosa, where several varieties of it have been described (cf. *7*). It is possible that sooner or later the *Sphaceloma* will be found there on this species, on one or more of its varieties and on still other species of the genus.

ON PLANTAGO MAJOR L

MASSACHUSETTS: Grafton, Sept. 14, 1940, O. C. Boyd*. Boyd (*2*) states that this *Sphaceloma* disease was observed in several parts of Massachusetts in 1941. QUEBEC, Rimouski, Sept. 20, 1939, J. Bt. Caron, Comm. E. Le Page (host as given on specimen is *P. major*).

[3] We are indebted to D. P. Pickel for the diagnosis in Latin.

[4] The specimens cited have been deposited in the Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering (USM), Plant Industry Station, Beltsville, Md., and in the herbarium of the Secção Fitopatologia, Instituto Biologico (IB), São Paulo, Brazil. Of the few undivided specimens, those represented only in the Mycological Collections are indicated by a dagger (†); those only in the Instituto Biologico, by a double dagger (‡). Specimens marked with an asterisk (*) have been selected for numbers in the Jenkins-Bitancourt "Myriangiales selecti exsiccati" (MSE), fascicles 5 and 6, in process of issue.

Grateful acknowledgement is made to those who contributed or assisted in collecting specimens, and also to the Grain and Seed Division, Agriculture Marketing Service, United States Department of Agriculture, and to Dr. S. F. Blake for identifications of *Plantago maior* and *P. rugelii*.

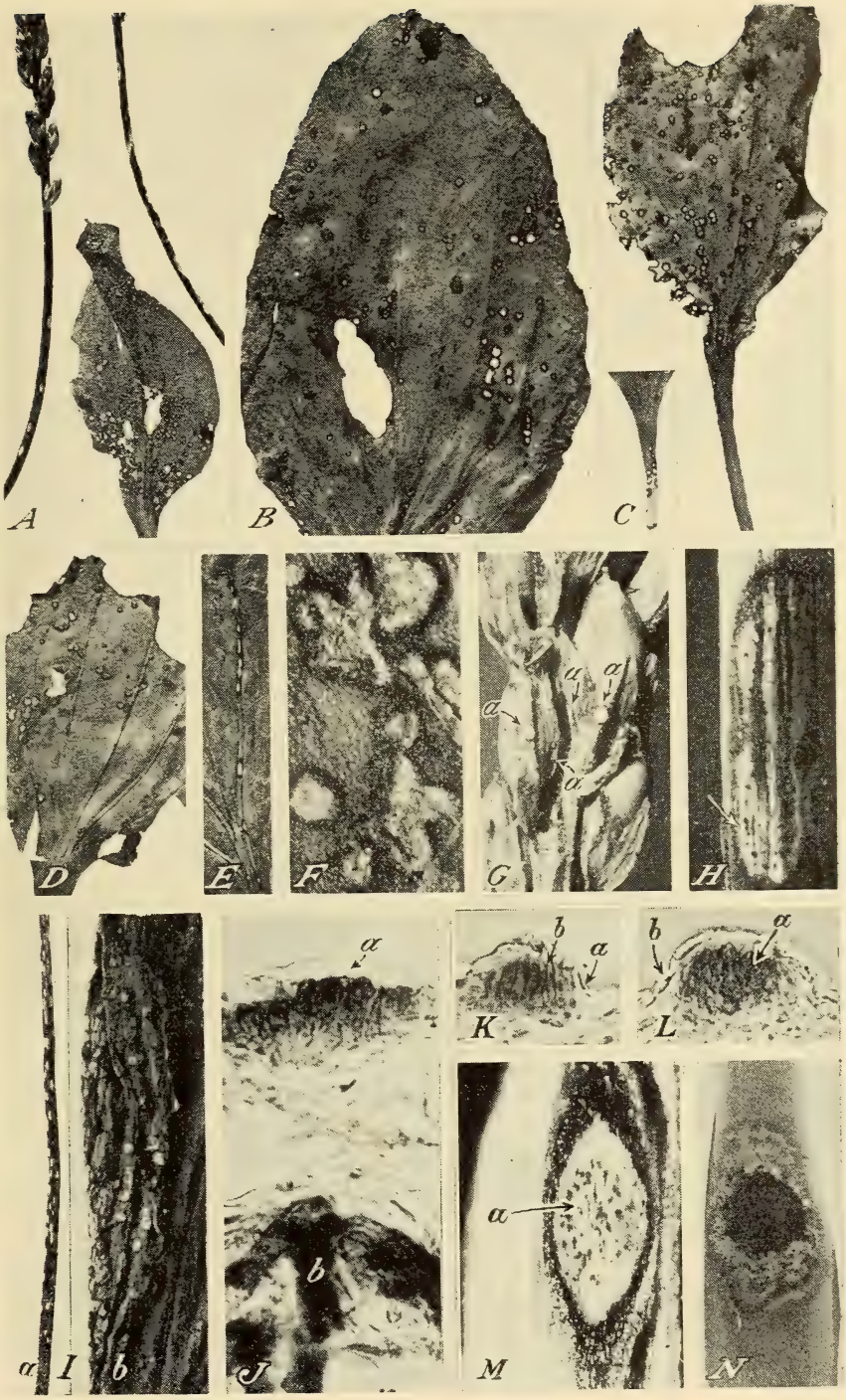


FIG. 1. *Sphaceloma plantaginis*. A–H, on *Plantago rugelii*, vic. Attica, Ind., Sept. 26, 1939: A–C, infection originating on upper leaf surface, A, also showing two infected peduncles; D and E, infection originating on lower leaf surface, E, on vein (A–E, ×1); F, leaf spots (×12); G, *a*, infection on sepals (×6); H, on stem, acervuli visible as dark punctate masses (×12). I, on *P. formosana*, Taihoku, Formosa, *a*, spotting on peduncle (×1); *b*, on leaf (×3½). J–M, from specimen from Indiana, J, vertical section through upper part of a hyperplastic leaf lesion, *a*, acervulus, *b*, hyperplastic leaf tissue, between *a* and *b*, lacerated leaf tissue interspersed with loose prosenchyma (×500); M, petiole canker dotted with acervuli (*a*) (×20); K, *b*, acervulus from M, rupturing epidermis (a); L, *a*, another acervulus from M, rupturing epidermis (*b*). (K and L, ×500.) N, old culture on Thaxter potato agar, (×1). Photographs by M. L. F. Foubert (A–H, J and N), R. L. Taylor (I), and Bitancourt (K–M).

ON PLANTAGO RUGELII Dcne.

DISTRICT OF COLUMBIA: *NW Section:* Vic. Bureau of Standards, June 11, 1944, J. A. Stevenson†; park at Connecticut Ave. and Kalorama Road, Aug. 31, 1940*, and Sept. 12, 1940*, A. E. Jenkins; California Street west of Connecticut Ave. July 23, 1941, A. E. Jenkins*; *SW Section:* Grounds, Washington Monument, east of Monument, June 30, 1940*, and Oct. 24, 1940*; northwest of Monument, Aug. 27, 1939*; west of monument, Sept. 13 and 14, 1940*, and Oct. 24, 1940*, A. E. Jenkins; The Mall, 14th Street between Madison Drive and Constitution Ave., July 14 and 16, 1941, A. E. Jenkins*; Madison Drive, between 12th and 13th Streets, June 5, 1940*; July 3, 1940;* Sept. 10, 1940* and July 21, 1941*, A. E. Jenkins; May 31, 1942, M. Bensaude and A. E. Jenkins†; grounds, U. S. National Museum, west of Museum, July 28, 1941*; July 10, 1942*; southwest of Museum, June 3, 1940*, A. E. Jenkins; near entrance to Smithsonian Institution Building, Aug. 8, 1939, A. A. Bitancourt and A. E. Jenkins‡; Aug. 28, 1940, A. E. Jenkins*; east of Freer Art Galley, May 31, 1940, L. Grodsinsky and A. E. Jenkins*; June 30, 1940*; also Aug. 30, 1940*, and June 23, 1941*; A. E. Jenkins; vic. Freer Art Gallery, July 10, 1942, A. E. Jenkins*; 12th Street near Maryland Ave., Aug. 28, 1940*, and Aug. 28, 1941*, A. E. Jenkins; *SE section:* Vic. Library of Congress Annex, Oct. 25, 1941, A. E. Jenkins and A. Marchant. ILLINOIS: Urbana, University of Illinois campus, Sept. 27, 1939, E. E. Honey, A. A. Bitancourt, and A. E. Jenkins. INDIANA: Attica, several miles west, Sept. 26, 1939, E. E. Honey, A. A. Bitancourt, and A. E. Jenkins* (type, USM 74085; IB 3413; MSE 253). MARYLAND: Beltsville, grounds, Plant Industry Station, Oct. 4 and 18, 1940, A. E. Jenkins*; Thurmont, Hi-Catoctoon Camp, June 9, 1940, E. O. Regis, R. Davidson, and A. E. Jenkins*. NEW YORK: Fishkill, Sept. 18, 1939* and July 4, 1945, A. E. Jenkins; Ithaca, near Cornell Univ. campus, July 16, 1940, F. M. Barrus and A. E. Jenkins*; on campus, Sept. 4, 1942, A. E. Jenkins*; State Street., Sept. 4, 1942, A. E. Jenkins; New York City, New York Botanical Garden, June 23, 1942; vic. New York Botanical Garden, July 3, 1945, A. E. Jenkins. OHIO: Wooster, Sept. 1940, P. E. Tilford*. PENNSYLVANIA: Walnut Shade, July 14, 1940, M. L. Bombard and A. E. Jenkins* (leaves and scapes from this specimen photographed in Dept. Plant Pathology, Cornell Univ., July 15, 1940). VIRGINIA: Chatham, Nov. 1, 1940, F. A. Wolf*. WISCONSIN: Madison, Aug. 1942, A. S. Costa*.

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ENTOMOLOGY.—*The Philippine mosquitoes of the genus* Aedes, *subgenus* Aedes.[1]

JEAN LAFFOON, PhM1c, U.S.N.R., U. S. Naval Medical Research Unit No. 2.
(Communicated by ALAN STONE.)

The majority of the specimens of mosquitoes used in this study were collected in the Philippines by members of a field unit of U. S. Naval Medical Research Uint No. 2. Additional material studied included specimens in the collections of the U. S. National Museum, Academy of Natural Sciences of Philadelphia, California Academy of Sciences, Philippine Bureau of Health, and the Museum of Comparative Zoology. I am indebted to Dr. Alan Stone, Dr. H. R. Roberts, Dr. E. S. Ross, F. E. Baisas, and Dr. Joseph Bequaert, respectively, for the opportunity to see these specimens. Dr. K. L. Knight, Dr. R. M. Bohart, and Dr. Stone offered numerous helpful criticisms and suggestions concerning this work. Dr. Ross kindly furnished the larval figures of *hamistylus* and *campylostylus*. Space in which to carry out this study was provided by the Division of Insects, U. S. National Museum.

About 50 species are now recognized in the subgenus *Aedes*. Of these the great majority are Oriental and Australasian. Thirteen species are known from the Philippines, six of them being described in this paper as new.

The terminology of the female genitalia as used here is principally that employed by Crampton (1942). The term "cowl" is avoided since it has been used to denote different structures by various authors. The term "atrial plate" has been used by several writers. However, for the purpose of this paper, the term "postatrial plate" (or plates) is applied to those structures forming the posterior wall of the atrium, and the term "preatrial plate" (or plates) for those forming the anterior wall. The preatrial plates, along with the preatrial sclerite, normally are folded over the postatrial plates. To obtain a good view of the important structures, it is necessary to mount the specimen with the preatrial sclerite and plates extended anteriorly, as shown in the figures. Careful manipulation with fine dissecting needles is necessary to accomplish this.

The terminology used for the larval head hairs is that adopted by Marshall (1938).

The only Oriental and Australasian species for which neither male nor female genitalia have been described or figured are *carmenti* Edwards (Australasian), *similis* (Theobald) (Australasian), *incertus* Edwards (Malay Peninsula, Borneo, and New Guinea), and *perditus* (Leicester) (Malay Peninsula). These species can be separated from all known Philippine species by the following characters: *incertus* (according to Edwards, 1924) has complete, conspicuous, white basal abdominal bands in both sexes; *perditus* (according to Leicester, 1908) has two long, sharp spines near the base of the larger claw of the male foreleg; *similis* (according to Theobald, 1910) has all claws of the female simple; and *carmenti* (according to Edwards, 1924) has dark upper sternopleural scales.

Because of the extreme external similarity of the Philippine species in many respects, the individual descriptions would be very repetitious if all the characters common to all species were noted in each description. However, some of these characters may well be valuable in distinguishing species as yet unknown. Therefore, a description of characters common to the known Philippine species follows:

Male antenna plumose, torus with a few tiny dark scales ventrally or medially or bare. Clypeus bare, dark brown. Palpus short in both sexes. Proboscis and labellum brown. Head scales mostly flat dark brown, with a pale lateral patch and some brown, upright, forked scales on nape. Scutal and scutellar scales narrow and curved. *Ppn* with about four bristles along the posterior margin. Patches of broad white scales on the propleuron, upper and posterior median portions of the sternopleuron, and on the upper part of the mesepimeron. Forecoxa with a small dorsal patch of flat pale scales, a larger patch of brown scales below these, and a small patch of flat pale

[1] Received May 2, 1946.

scales ventrally on the anterior aspect; mid and hind coxae each with a patch of pale scales. Femora pale below to or nearly to apex, remainder of legs entirely dark. Wings dark-scaled. Tergite I always with white scales along lateral border.

KEY TO MALES

1. Abdominal tergites II–VIII always with some white or yellowish basolateral markings, sometimes produced onto dorsum, sometimes reduced to a few scales; hind claws always simple....2
   Abdominal tergites II–VIII entirely brown; mesepimeron never with more than 3 or 4 hairs behind scale patch; about 5–10 small upright forked scales on nape on each side of midline; about 12 verticillate bristles on most antennal segments....11
2. Anterior median portion of sternopleuron with about 15 hairs; sternites almost entirely white....3
   Anterior median portion of sternopleuron without hairs, or with only 1 or 2 (rarely up to about 8 in *umbrosus*)....5
3. Ninth tergite with a very large median Y-shaped process about as long as basistyle, each branch with an additional hairy branch on its ventral surface.... *macrodixoa* Dyar and Shannon
   Ninth tergite without such a process....4
4. Basistyle with a group of about 8 stout spines on the inner ventral margin; paraproct short; two very long processes arising near apex of basistyle, one with about 3 stout spines near tip.... *uncus* (Theobald)
   Inner ventral margin of basistyle without a group of stout spines; paraproct longer than basistyle; a broad process near apex of basistyle with a row of about 4 heavy spines apically.... *nubicolus*, n. sp.
5. Meteusternum with numerous fine hairs; fore and mid legs with claws unequal, the larger ones uniserrate, the smaller simple; basistyle with a group of about 8 stout spines on the inner ventral margin near the base..6
   Meteusternum without hairs; basistyle without such a group of spines....8
6. Apicodorsal prolongation of basistyle very wide with its two distal forks about equal in length; only 2 other long apical processes, sometimes a more ventral short spine also visible (Fig. 9); Balabac.... *adustus*, n. sp.
   Apicordorsal prolongation of basistyle otherwise; three other long apical or subapical processes present....7
7. Apicodorsal prolongation of basistyle very wide (Fig. 7); Mindanao, Basilan, and Leyte.... *johnsoni*, n. sp.
   Apicordorsal prolongation of basistyle much narrower (Fig. 8); Luzón and Mindoro.... *margarsen* Dyar and Shannon
8. At least 10 hairs on posterior and ventral parts of mesepimeron, usually more numerous....9
   Mesepimeron with a number of bristles along upper margin but with no hairs ventral to scale patch and never more than 3 or 4 behind it....10
9. About 12 verticillate bristles on most antennal segments; upper sternopleural scale patch usually extending to anterior median angle of sclerite; claws of fore and midlegs equal, toothed; abdominal sternites II–VII with a wide basal white band, covering at least basal two-thirds of each segment; dististyle simple.... *panayensis* Ludlow
   About 20 verticillate bristles on most antennal segments; upper sternopleural scale patch never extending to anterior median angle of sclerite; claws of foreleg unequal, both toothed; claws of midleg equal, both simple; sternites entirely brown, or with a few white scales on basal one-third; dististyle forked.... *umbrosus* Brug
10. Scutal integument reddish brown; smaller claws of fore and midlegs each with a small tooth; sternites II–VII with about basal two-thirds of each segment white; basistyle with a large patch of flat white scales laterally; paraproct forked beyond middle.... *campylostylus*, n. sp.
    Scutal integument blackish brown; smaller claws of fore and midlegs simple; sternites II–VII entirely brown; basistyle with flat brown scales only; paraproct simple.... *nigrotarsis* (Ludlow)
11. Larger claw of midleg simple, smaller claws of fore and midlegs each with a small tooth (genitalia as in Fig. 2)... *hamistylus*, n. sp.
    Larger claw of midleg with a prominent tooth, smaller claws of fore and midlegs simple.12
12. Hind claws each with a prominent tooth (genitalia as in Fig. 3).... *robertsi*, n. sp.
    Hind claws simple (genitalia as in Fig. 6).... *dux* Dyar and Shannon

KEY TO FEMALES

1. Abdominal tergites II–VIII always with some white or yellowish basolateral markings, sometimes produced onto dorsum, sometimes reduced to a few scales; hind claws always simple....2
   Abdominal tergites II–VIII entirely brown; about 5–10 small upright forked scales on nape on each side of midline; mesepimeron never with more than 3 or 4 hairs behind scale patch....8
2. Anterior median portion of sternopleuron with about 15 hairs; sternites almost entirely white....3
   Anterior median portion of sternopleuron bare of hairs or with only 1 or 2 (rarely up to about 8 in *umbrosus*)....4
3. Atrial hairs confined to median area; preatrial

plates not united.....
.....*macrodixoa* Dyar and Shannon
Atrial hairs not confined to median area; preatrial plates united for greater part of their length.....*uncus* (Theobald)

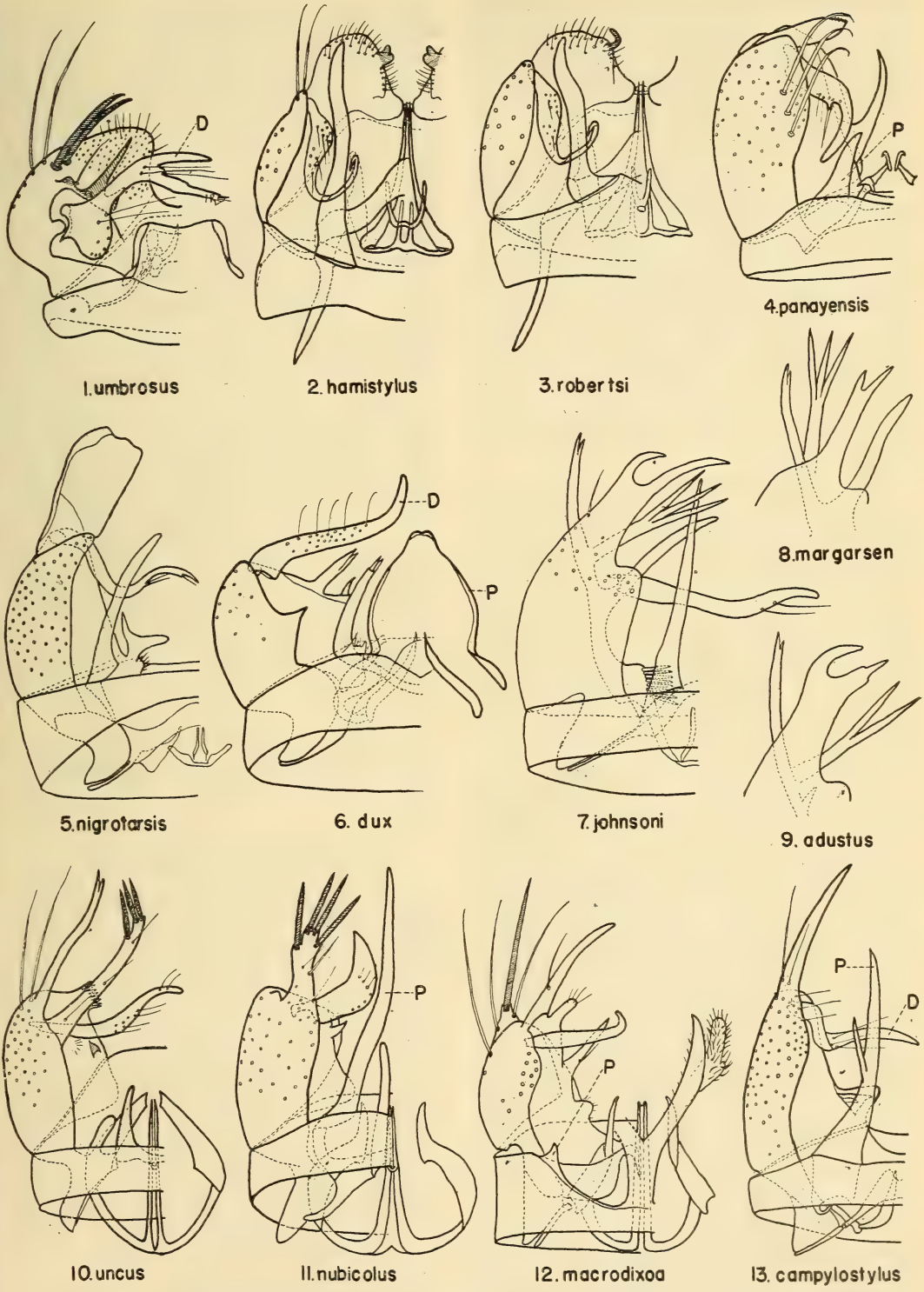
4. Meteusternum with numerous fine hairs....
.....*adustus*, n. sp.
johnsoni, n. sp.
margarsen Dyar and Shannon
Meteusternum without hairs.....5
5. At least 10 hairs on posterior and ventral parts of mesepimeron, usually more numerous.....6
Mesepimeron with a number of bristles along the upper margin but no hairs ventral to the scale patch and never more than 3 or 4 behind it.....7
6. Upper sternopleural scale patch usually extending to anterior median angle of sclerite; sternites II–VII with a wide basal white band covering at least basal half of segments; postatrial sclerite not trilobed.....
.....*panayensis* Ludlow
Upper sternopleural scale patch never extending to the anterior median angle of sclerite; abdominal sternites entirely dark brown or with some white scales on basal one-third; postatrial sclerite trilobed.....
.....*umbrosus* Brug
7. Scutal integument reddish brown; sternites II–VII with about basal two-thirds white; no large round dark preatrial plate.....
.....*campylostylus*, n. sp.
Scutal integument blackish brown; sternites II–VII entirely brown; a large round heavily pigmented preatrial plate in addition to the paired preatrial plates.....
.....*nigrotarsis* (Ludlow)
8. Hind claws simple; a pair of hairy processes anterior to the spermathecal eminence....
.....*dux* Dyar and Shannon
Hind claws toothed; no paired hairy processes anterior to the spermathecal eminence...9
9. Postatrial area with areas of densest sclerotization as shown in Fig. 16.....
.....*hamistylus*, n. sp.
Postatrial area with areas of densest sclerotization as shown in Fig. 15..*robertsi*, n. sp.

KEY TO KNOWN LARVAE

1. Comb scales with a complete apical fringe, no prominent terminal spine; pentad hair 2 of abdominal segment VIII with 4–5 branches; mentum with 11–13 teeth on each side...
.....*umbrosus* Brug
Comb scales with a distinct terminal spine; pentad hair 2 of abdominal segment VIII with 1–3 branches.....2
2. Mentum with 8–11 teeth on each side; anal gills 1.0–1.5 times as long as anal plate...
.....*dux* Dyar and Shannon
Mentum with 13 or more teeth on each side; anal gills at least 1.7 times as long as anal plate.....3
3. Head hair 5 with at least 5 branches (very rarely 4); head hair 6 with at least 4 branches.....4
Head hairs 5 and 6 with not more than 3 branches each.....5
4. Mentum with 18–20 teeth on each side; prothoracic hair 2 single; prothoracic hair 8 double.....*campylostylus*, n. sp.
Mentum with 14–18 teeth on each side; prothoracic hair 2 single or double (usually double); prothoracic hair 8 single or double (usually single).....
.....*johnsoni*, n. sp.
margarsen Dyar and Shannon
5. Dorsolateral hair (hair 6) of abdominal segment I single; pentad hair 1 of abdominal segment VIII single, pentad hair 3 with 2–3 branches; anal gills at least 5 times as long as anal plate.....*robertsi*, n. sp.
hamistylus, n. sp.
Dorsolateral hair of segment I with 2 or more branches; pentad hair 1 with 3–5 branches, pentad hair 3 with at least 5 branches; anal gills not more than 3.5 times as long as anal plate.....*nigrotarsis* (Ludlow)

Aedes (Aedes) robertsi, n. sp.

Male.—Wing: 1.8–2.1 mm. *Head:* About 10 verticillate bristles on most antennal segments; torus brownish yellow dorsolaterally, remainder dark brown, bare or with a few flat dark scales on median aspect. Head scales mostly flat dark brown, a lateral patch of flat white scales; 2 or 3 pale scales between the eyes; about 5 dark-brown, forked, upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum dark brown, clothed with golden-brown, narrow, curved scales, black in some lights. *Apn* brown, with about 7 large bristles, bristles, bare or with some flat pale scales. *Ppn* brown, bare. Pleuron brown. Anterior median portion of sternopleuron bare. About 10 bristles on upper part of mesepimeron, remainder of mesepimeron without bristles or hairs. Meteusternum bare. Claws of fore and midlegs unequal, the larger ones toothed, the smaller ones simple; claws of hind legs small, equal, toothed. *Abdomen*: Tergites all brown except for a pale lateral patch on segment I. Sternites entirely brown. *Genitalia* (Fig. 3): Basistyle with a large apical prolongation directed mesad, joined to the prolongation of the opposite side by a short sclerotized bar. Prolongation with a stout spine on inner posterior surface, directed medially and posteriorly, then curving ventrally and posteriorly. Two strong bristles close to outer base of prolongation, several other bristles very close to these, a total



FIGS. 1–13.—Male genitalia. D, dististyle; P, paraproct.

of about 20 bristles on the basistyle. Dististyle curved, enlarged before middle, two patches of hairs on enlarged portion, the proximal patch with about 8 hairs, the distal patch with about 6; tip of dististyle hooked. Paraproct long, curved dorsad.

Female.—Wing: 2.3–2.7 mm. Torus with some flat dark scales on median aspect. Claws of all legs equal, toothed. *Genitalia* (Fig. 15): Cercus and postgenital plate unusually narrow. Postgenital plate barely emarginate. Postatrial area with characteristic thickened areas. A large hairy median preatrial plate, posterior portion extending into postatrial area (if the preatrial area is not extended in mounting, the plate will resemble a small hairy sphere). Preatrial sclerite very broad laterally, anterior margin with a pair of submedian lobes (poorly seen in most views).

Larva.—Head: Hair 11 (antennal tuft) single, smooth, inserted at or just beyond middle of shaft; hair 4 small, with 2–3 branches; 5 with with 2–3; 6 with 2–4; 7 with 2–5; 8 with 2–4; 9 with 3–6; 14 with 2–3. Mentum with 16–19 teeth on each side. *Abdomen:* Hair 7 of segment I and hair 6 of segments I–VI all single. Comb scales with a distinct terminal spine and a fine lateral fringe, arranged in an irregular row, 9–12 in number. Pentad hair 1 of segment VIII single; hair 2 with 1–3 branches; hair 3 with 2–5; hair 4 single; 5 with 3–5. Siphonal index 3.6–3.9; 5–8 pecten teeth, distal tooth inserted at 0.6–0.8 the length of the siphon, teeth with 2–5 small lateral denticles on the ventral side, spacing between the teeth nearly regular; hair tuft inserted at 0.75–0.90 the siphonal length, distal to and about in line with the last pecten tooth, 1–3-branched. *Isc* 2–3-branched; *Ith* 1–2 branched, about one-half as long as anal plate; ventral brush with about 12 tufts, all tufts with several branches, anterior two sometimes only 1–2-branched; anal gills extremely long, apparently about 6 times as long as anal plate.

Holotype.—Male, in Academy of Natural Sciences of Philadelphia, from Tacloban, Leyte, September 15, 1945, collected as a larva in a gravel-bottomed residual pool in a dry stream bed (H. R. Roberts).

Paratypes.—Eight males, 11 females, 13 whole larvae. Same data as for holotype. Deposited in the Academy of Natural Sciences of Philadelphia, U. S. National Museum, British Museum, and California Academy of Sciences.

Remarks.—This species is very closely related to *uniformis* (Theobald) (India) and *abditus* Barraud (India), and apparently to *fragilis* (Leicester) (Malay Peninsula), *indecorabilis* (Leicester) (Malay Peninsula), and *yusafi* Barraud (India). The hind claws of both sexes, where known, of these species are toothed (hind claws of *indecorabilis* have not been described). This condition is found also in *robertsi* and *hamistylus* but is unknown in any other members of the subgenus except the female of *esoensis* Yamada. Yamada (1921) states that the hind claws of the female of that species are subject to variation, sometimes being simple, sometimes with one or more teeth. *A. robertsi* and *hamistylus* differ from *fragilis, indecorabilis,* and *yusafi* in lacking white markings on the abdominal tergites; from *uniformis* in the shape of the apical prolongation of the basistyle, in possessing a spine on the border of this prolongation, and in other details of the male and female genitalia; and from *abditus* in details of the sclerotized areas of the postatrial area of the female. *Verrallina malayi* Leicester, which has been considered a synonym of *uncus,* is related to the species mentioned (on the basis of the description of Leicester, 1908) and is possibly synonymous with *fragilis.*

This species is named for the collector, to whom I am indebted for the opportunity of seeing many of the specimens used in this study.

Aedes (Aedes) hamistylus, n. sp.

Adult.—Apparently indistinguishable from *robertsi* except by the following characters: Male with claws of foreleg unequal, both toothed; claws of midleg unequal, the larger one simple, the smaller one toothed. *Male genitalia* (Fig. 2): Apical prolongation of basistyle more rounded than in *robertsi,* base of its inner posterior projection larger, with only a short blunt projection arising from it. Basistyle with 2 bristles close to outer base of prolongation, but with an area free of bristles for some distance anterior to these, a total of about 10 bristles on the basistyle. *Female genitalia* (Fig. 16): Very similar to *robertsi,* but the areas of densest sclerotization in the postatrial area differing.

Larva (Fig. 25).—Apparently indistinguishable from *robertsi.*

Holotype.—Male, U.S.N.M. No. 57974, from Cape Melville, Balabac, June 23, 1945, collected as a larva in a gravel-bottomed residual pool in a dry stream bed (Jean Laffoon).

Paratypes.—Forty-one males, 63 females, 8 whole larvae, 4 larval skins, 1 pupal skin (all skins associated with adults). BALABAC: Cape Melville, June 1945 (A. T. Fitzjarrell, D. R. Johnson, Jean Laffoon). MINDORO: San José, April and May 1945 (E. S. Ross). Deposited in U. S. National Museum, British Museum, Academy of Natural Sciences of Philadelphia, and California Academy of Sciences.

Biology.—Dr. E. S. Ross has supplied the following notes in a personal communication. "My series was collected in a *Pandanus* swamp. The larvae were never observed breathing at the surface and seemed able to remain indefinitely at the bottom because of the possible gill function of their long anal papillae with pronounced tracheation. They were collected by dredging leaves from the bottom. Pupae were common at the surface. In the laboratory the larvae seemed to prefer hiding under leaves in the culture jars, 'attaching' to the surface by means of their mouth brushes. The papillae appear bluish white and are held widely outspread."

Aedes (Aedes) dux Dyar and Shannon

Aedes (*Aedes*) *dux* Dyar and Shannon, 1925, p. 81. (Type locality: Philippine Islands. Holotype male in U.S.N.M.)

Aedes (*Aedes*) *macrodixoa* Dyar and Shannon, Bohart, 1945; p. 65 and fig. 52 (female only).

Male.—Wing: 1.6–2.0 mm. *Head:* About 10 verticillate bristles on most antennal segments; torus dark brown, sometimes paler dorsolaterally, bare. Head scales mostly flat, dark brown; a lateral spot of pale flat scales; sometimes a few narrow curved scales bordering eye, a few pale flattened scales between the eyes; about 5 tiny, dark brown, forked, upright scales on nape on each side of midline (often hidden). *Thorax:* Integument of scutum and scutellum dark brown, clothed with golden-brown, narrow, curved scales, black in some lights. *Apn* with about 8 bristles, bare. *Ppn* bare or with a few narrow scales along dorsal margin. Pleuron brown. About 3–7 bristles along the upper margin of the mesepimeron, remainder of mesepimeron without bristles or hairs, occasionally 1 or 2 hairs behind scale patch. Meteusternum bare. Claws on fore and mid legs unequal, the larger ones toothed, the smaller ones simple; claws on hind legs small, equal, simple. *Abdomen:* Tergites entirely brown except tergite I pale-scaled laterally, last few tergites sometimes with an indefinite basolateral patch of brown scales somewhat paler than those on the remainder of the abdomen. Sternites brown. *Genitalia* (Fig. 6): Basistyle very short, along the inner margin a heavy, double-tipped spine, a shorter curved spine, and a projection with 2 small spines near tip. Dististyle inserted near outer margin apically, enlarged near base and curved posteriorly before apex, numerous hairs near middle. Paraprocts slender, fairly long, tenth tergite distinct, with numerous minute hairs.

Female.—Wing: 2.1–2.6 mm. Torus with a few rather narrow dark scales on inner aspect. Claws on fore and mid legs equal, toothed; claws on hind leg equal, simple. *Genitalia* (Fig. 19): Postgenital plate emarginate. Postatrial sclerite narrow, barely convex posteriorly, weak medially. Postatrial plate with a pair of hairy, fingerlike processes articulated anteriorly, a row of short hairs extending medially and posteriorly from the base of these. Preatrial sclerites widely disjoined.

Larva (Fig. 29).—*Head:* Hair 11 with 5–10 branches, inserted before middle of shaft; hair 4 very small, with 3–5 branches; 5 with 2–4; 6 with 3–4; 7 with 7–12; 8 with 2–3; 9 with 1–3; 14 with 2–5. Mentum with 8–11 lateral teeth. *Abdomen:* Hair 6 of segment I double, occasionally triple; hair 7 of segment I single; hair 6 of segment II double, occasionally triple; hair 6 of segments III–VI single. Comb scales with a distinct terminal spine and a fine lateral fringe, 8–13 in number. Pentad hair 1 with 3–6 branches; 2 with 1–2; 3 with 5–8; 4 single; 5 with 6–10. Siphonal index about 2.6; hair tuft 4–8 branched; 7–13 pecten teeth, last tooth inserted before middle, all teeth usually having a well-formed lateral denticle on the ventral side, tending to be somewhat smaller on the distal teeth, sometimes 3–4 lateral denticles, dorsal side of spines usually bare, sometimes with a small denticle; distal 1–3 teeth somewhat more widely spaced than those nearer base. *Isc* 5–8 branched; *lh* single, about as long as anal plate; ventral brush with about 12 tufts of which at least the anterior one is off the well-developed grid, each tuft many-branched;

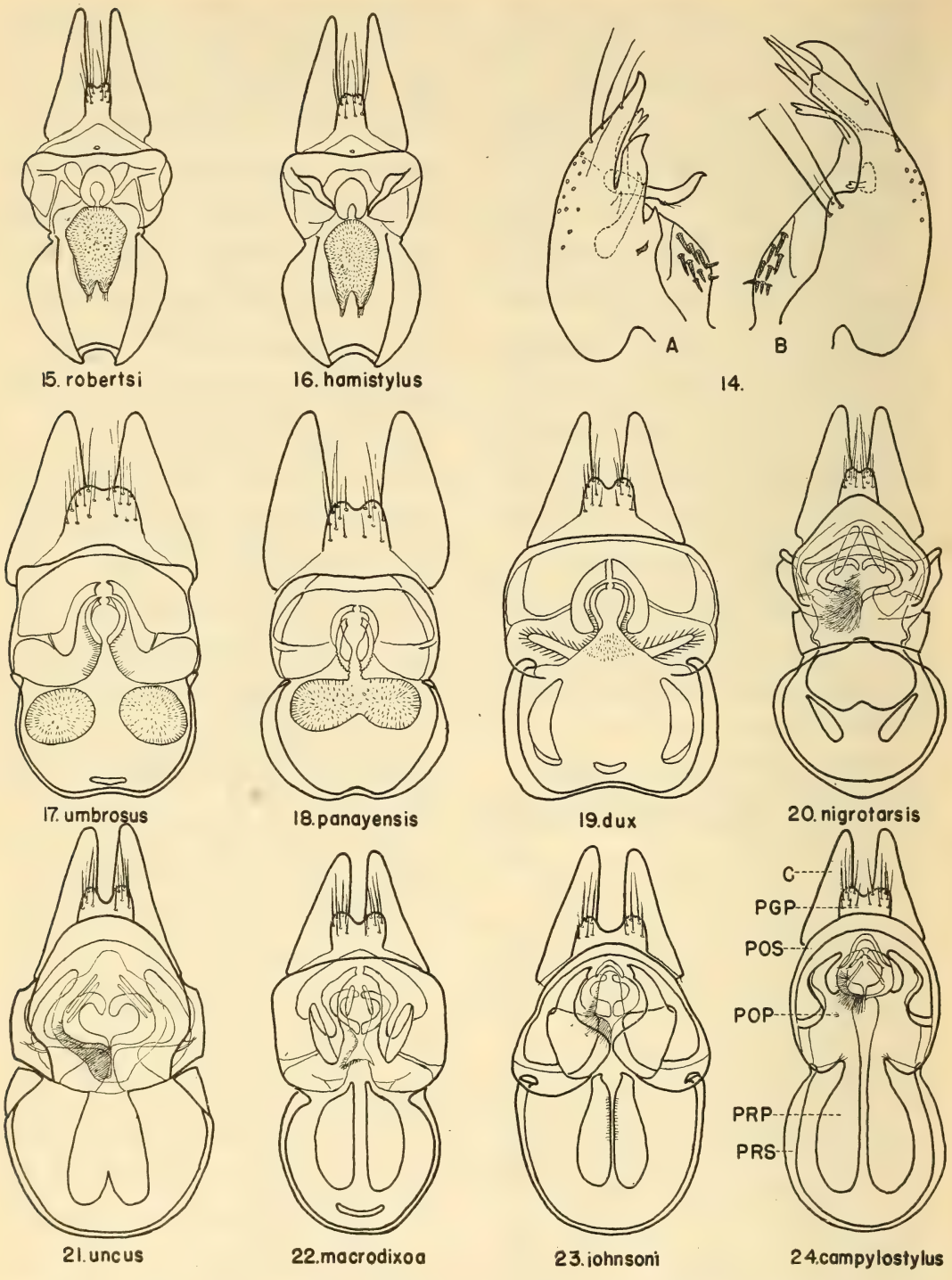


FIG. 14, *a* and *b*.—Genitalia of a male from Balabac (see remarks under *adustus*).
FIGS. 15–24.—Female genitalia. C, cercus; PGP, postgenital plate; POS, postatrial sclerite; POP, postatrial plate; PRP, preatrial plate; PRS, preatrial sclerite.

anal gills slightly tapering, bluntly tipped, 1.0–1.5 times the length of the anal plate.

Biology.—The larvae have been collected in fresh water in footprints in a ricefield near a mangrove swamp. N. Angeles reared a series from eggs in the laboratory in fresh water. Causey (1937) stated that "larvae were found in fresh and brackish water." The adults have been taken in light traps.

Distribution.—Specimens have been examined from the following localities: LUZÓN: Camp Nichols, Rizal (Pvt. Carraway, J. J. Larkin, R. F. Longacre, G. McDonald); Las Pinas, Rizal (F. E. Baisas); Tungkong Manga, San José, Bulacan (N. Angeles); Manila (D. Fox, Harry Hoogstraal); Subic Bay (M. J. MacMillan); Camp Stotsenberg, Pampanga. MINDORO: Caminawit Point (G. H. Penn); MINDANAO: Zamboanga (K. L. Knight, Jean Laffoon). Previously recorded from Luzón, Java, Singapore, and Siam.

Remarks.—The male and female genitalia readily separate this from all other known species except *sigmoides* Barraud, which Causey (1937) considered a synonym of *dux*. However, Barraud states that the holotype of *sigmoides* has white basolateral abdominal spots, and as Philippine specimens of *dux* lack such spots, this synonomy must be considered questionable at present. The female which Bohart (1945) figured as *macrodixoa* has been examined and found to be *dux*.

Aedes (Aedes) johnsoni, n. sp.

Male.—Wing: 2.5–2.9 mm. *Head:* Over 20 verticillate bristles on most antennal segments; torus brownish yellow dorsolaterally, remainder dark brown, a few very small, rather narrow, dark-brown scales medially. Head scales mostly flat, dark brown; a lateral patch of flat white scales; usually some narrow, curved, golden scales behind the eyes, extending downward for a short distance between the eyes; a number of dark brown, forked, upright scales on nape, sometimes a few pale flat scales near their bases; often a few golden, narrow, curved scales along the midline, sometimes extending forward to the eye border. *Thorax:* Integument of scutum and scutellum dark brown, clothed with golden-brown, narrow, curved scales, black in some lights, paler scales on anterior margin of scutum and above the wing base. *Apn* with about 12 large and some smaller bristles, bare or with a few flat white scales, rarely with a few pale narrow curved scales. *Ppn* usually with light-brown, narrow, curved scales on the dorsal half, sometimes with a few flat pale scales, sometimes bare. Pleuron dark brown. Anterior median angle of sternopleuron without scales or hairs. A number of bristles along the upper margin of the mesepimeron, numerous fine hairs posterior and ventral to the scale patch, ventral one-fourth of sclerite bare. Meteusternum with numerous fine pale hairs anteriorly. Claws on fore and mid legs unequal, the larger ones with a distinct tooth, the smaller ones simple; claws on hind leg small, equal, simple. *Abdomen:* Tergites dark brown with basolateral white spots on segments II–VIII with apices directed dorsoposteriorly, sometimes barely produced onto the dorsum of some segments. Sternites II–VII with white scales basally, brown scales apically; sternite VIII all white. *Genitalia* (Fig. 7): Basistyle with a long, wide, flattened prolongation apically on the dorsal aspect, this process much wider than any of the other processes, prolongation with a deep rounded notch apically, the anterior fork about twice as long as the posterior. Ventral to this prolongation three other subapical processes, the first split near the tip, the second a 3–4-branched forklike process, the third a long simple process. About 8 strong spines on ventral aspect of basistyle near base. Dististyle subapical, slender, curved, 2 hairs arising before tip. Paraproct very long, simple.

Female.—Wing: 2.8–3.6 mm. Torus with a few dark scales medially. Claws of fore and mid legs equal, toothed; claws of hind legs equal, simple. Abdominal spots somewhat larger than in male, usually visible from above on segments II–VIII. Sternite VIII mostly brown. *Genitalia* (Fig. 23): Postgenital plate emarginate. Postatrial sclerite narrow, unevenly rounded. Postatrial plate broad, with a characteristic posterior arm. Postatrial hairs confined to median area. Preatrial plates proximated but not united.

Larva.—Head: Head hair 11 with 3–5 feebly plumose branches, inserted before middle of shaft; hair 4 very small, with 4–7 branches; 5 with 5–10; 6 with 4–8; 7 with 10–14; 8 with 1–2; 9 with 3–6; 14 with 3–5. Mentum with 14–18 teeth on each side (average of 102 cases, 15.7). *Thorax:* Prothoracic hair 2 single or double (usually double); hair 8 single or double

(usually single). *Abdomen:* Hair 6 of segment I double; hair 7 single, rarely double; hair 6 of segment II double, occasionally triple; hair 6 of segments III–VI single, one or more sometimes double. Comb scales with a distinct terminal spine and a fine lateral fringe, 10–14 in number. Pentad hair 1 of segment VIII with 4–6 branches, 2 double, 3 with 3–7, 4 double, 5 with 6–9. Siphonal index about 3.0; 14–20 pecten teeth, distal tooth inserted beyond middle, basal teeth with 1–3 small lateral denticles, distal 2–5 teeth simple or with a very small lateral denticle, distal 2–5 teeth more widely spaced than those nearer base; siphonal tuft 2–5-branched. *Isc* 5–7-branched; *lh* single, shorter than anal plate; ventral brush with about 12 tufts, each tuft many-branched; anal gills lanceolate, pointed, the dorsal pair slightly longer than the ventral pair, 1.9–3.0 times length of the anal plate.

Holotype.—Male, with associated larval and pupal skins, U.S.N.M. No. 57975, from Pasananonco, Mindanao (near Zamboanga), September 18, 1945, collected in a muddy road rut in a coconut grove (D. R. Johnson).

Paratypes.—Forty-one males, 44 females, 15 whole larvae, 38 larval skins, 37 pupal skins (all skins associated with adults). MINDANAO: San Ramón, Zamboanga and Pasananonco, September 1945 (K. L. Knight, D. R. Johnson, Jean Laffoon). BASILÁN: Isabela, September 1945 (K. L. Knight). LEYTE: Tanauan, November 1944 (H. R. Roberts). Deposited in U. S. National Museum, British Museum, Academy of Natural Sciences of Philadelphia, and California Academy of Sciences.

Biology.—The larvae have been collected several times in muddy pools and road ruts. Adults have been taken in the jungle during the day.

Remarks.—*A. andamanensis, margarsen, adustus,* and the present species form a very closely knit complex. They are distinct from all other known species in the character of the prolongation and processes at the apex of the basistyle. The three Philippine species differ from other Philippine *Aedes* (*Aedes*) in the presence of numerous fine hairs on the meteusternum. From the description and figures of *andamanensis* (Edwards, 1922; Barraud, 1928 and 1934) and from examination of adults and genitalia of the three Philippine species, it would appear that the only method of separating the four members of this complex is by means of the male genitalia. These differ from each other in the character of the prolongation and processes at the apex of the basistyle. The three Philippine forms should perhaps be considered subspecies of *andamanensis,* but until a study can be made of their biology and of more material from various parts of the range, it is thought best to recognize them as full species. The larvae of *johnsoni* and *adustus* are apparently indistinguishable and the larva of *campylostylus* is very similar.

This species is named for one of the collectors, D. R. Johnson, whose interest in mosquito collecting has added materially to the knowledge of the Philippine mosquito fauna.

Aedes (Aedes) adustus, n. sp.

Adult.—The external characters and female genitalia appear to be indistinguishable from *andamanensis, johnsoni,* and *margarsen. Male genitalia* (Fig. 9): Very similar to the three species mentioned. The most ventral of the processes at the apex of the basistyle is very short (difficult to find, apparently absent in some specimens), while in the three closely related species it is well developed. Only 2–3 branches in the forklike subapical process. Apicodorsal prolongation of basistyle with anterior fork only slightly longer than posterior.

Larva.—Unknown.

Holotype.—Male, U.S.N.M. No. 57976, from Cape Melville, Balabac, P.I., June 23, 1945 (D. E. Howell), reared from larva collected in a shaded road rut.

Paratypes.—Six males, 6 females. Same locality and date as holotype (D. R. Johnson, Jean Laffoon, A. T. Fitzjarrell). Deposited in U. S. National Museum and British Museum.

Biology.—The larvae have been collected in shaded road ruts and in a shaded, gravel-bottomed residual pool in a dry stream bed.

Remarks.—A very unusual specimen was taken as a larva in the residual pool from which part of the type series of *adustus* was taken. It is inseparable from the male of *adustus* on external characters, but the genitalia (Fig. 14, *a* and *b*) are asymmetrical. One side is rather similar to *adustus,* while the other is very odd, showing some similarity to *campylostylus* and some to *adustus.* The larvae of *campylostylus, hamistylus,* and *uncus* were collected in this

same pool. The specimen is in the U. S. National Museum.

Aedes (Aedes) margarsen Dyar and Shannon

Aedes (*Aedes*) *margarsen* Dyar and Shannon, 1925, p. 80. (Type locality: Camp Eldridge, Laguna, Luzón. Male lectotype here designated from series of 4 male and 4 female cotypes, in U.S.N.M.)

Adult.—Apparently indistinguishable on external characters or on the female genitalia from *andamanensis*, *johnsoni*, and *adustus*. The white markings on abdominal tergites of female extremely variable; a pale, subbasal, median spot often present on I, II–VII often with lateral spots produced well onto dorsum, sometimes forming a complete transverse subbasal band. *Male genitalia* (Fig. 8): Very similar to *johnsoni* and *andamanensis* except that the apicodorsal prolongation of the basistyle is narrower, not much wider than the other subapical processes; 2–4 branches in the forklike subapical process.

Larva.—Apparently inseparable from the larva of *johnsoni*. The mentum has 13–17 teeth on each side (average of 28 cases, 14.5).

Biology.—The larvae have been taken in road rut pools.

Distribution.—Material has been examined from the following localities: LUZÓN: Camp Eldridge (E. Vazquez); Los Banos and Calamias, Laguna (F. E. Baisas); Tungkong Manga San José, Bulacan (N. Angeles); Subic Bay (F. E. Zedeck); San Anastacio (A. B. Gurney). MINDORO: San José (E. S. Ross).

Remarks.—Napoleon Angeles has reared a series from eggs from a known adult at Tungkong Manga. The transverse abdominal bands are complete in some of the females in this series, and broadly interrupted in others.

Aedes (Aedes) nubicolus, n. sp.

Aedes (*Aedes*) *uncus* (Theobald), Bohart, 1945, p. 66 and fig. 50 (male only).

Male.—Wing: 3.0 mm. *Head:* Over 20 verticillate bristles on most antennal segments; torus dark brown ventrally, paler dorsally. Head scales mostly flat dark brown, a lateral patch of flat, white scales, a few pale scales along eye border and between the eyes, a few pale scales anterior to nape, about 20 brown forked upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum orange-brown, clothed with golden, narrow, curved scales, black in some lights, paler scales on anterior border of scutum and above wing bases. *Apn* orange-brown with about 10 bristles. *Ppn* orange-brown with a few scales on the dorsal half similar to those on the scutum. Pleuron orange-brown. About 15 hairs on anterior median part of sternopleuron. About 15 upper mesepimeral bristles and numerous hairs on the posterior and ventral parts of this sclerite, extending into the ventral one-fourth. Claws of fore and mid legs unequal, the larger ones toothed, the smaller ones simple; claws of hind legs small, equal, simple. *Abdomen:* Tergites dark brown, II–VIII with white basolateral spots with apices directed dorsoposteriorly, barely visible from above on segments IV–VII. Sternites mostly white. *Genitalia* (Fig. 11): Basistyle with a fairly short subapical process dorsally, bearing about 4 very heavy spines apically and several bristles. Inner aspect of basistyle with a rather small triangular sclerotized plate. Dististyle subapical, simple, very broad near middle, about 8 fine hairs near the widest part. Paraproct simple, very long.

Female and larva.—Unknown.

Holotype.—Male, in Museum of Comparative Zoology, from Sibulan River at 7,000–8,000 feet on Mount Apo (near Dávao), Mindanao, September 23 (C. S. Clagg).

Paratype.—Male, same data as for holotype. Deposited in Museum of Comparative Zoology.

Remarks.—This species is apparently indistinguishable externally from *macrodixoa* and *uncus*. The male genitalia are distinct from all species for which the male is known, but it is not impossible that this may be the male of some species of which the female only is known at present.

Aedes (Aedes) uncus (Theobald)

Culex uncus Theobald, 1901, p. 53. (Type locality: Selangor, Malay Peninsula. Type: Female in British Museum.)

Aedes (*Aedes*) *uncus* (Theobald), Bohart, 1945, p. 66 and fig. 56 (female only).

Male.—Wing: 2.6–3.0 mm. *Head:* Over 20 verticillate bristles on most antennal segments; torus dark brown ventrally, paler dorsally, bare. Head scales mostly flat dark brown, a lateral patch of flat, white scales, a few pale scales along eye margin and between the eyes, a

few narrow pale scales along the midline, at least 15 dark-brown, forked, upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum orange-brown, clothed with golden-brown, narrow, curved scales, black in some lights, paler scales on anterior border of scutum and above wing base. *Apn* orange-brown with about 7 large and some smaller bristles. *Ppn* brown, with some fine hairs and a number of scales on the dorsal half similar to those on the scutum. Pleuron orange-brown. About 15 hairs on anterior part of sternopleuron. About 15 upper mesepimeral bristles and numerous hairs on the posterior and ventral parts of this sclerite, extending into the ventral one-fourth. Claws of fore and mid legs unequal, the larger ones toothed, the smaller ones simple; claws of hind leg equal, small, simple. *Abdomen:* Tergites dark brown, II–VIII with white basolateral spots with apices directed dorsoposteriorly, barely visible from above. Sternites I–VII mostly white, with a few brown scales apically; sternite VIII all white. *Genitalia* (Fig. 10): Basistyle with two long processes. Posterior process split near tip, without bristles, the other with 3–4 large heavy spines near apex and 2 or 3 small bristles along length. An irregular row of about 9 stout spines along inner ventral margin. Inner aspect with a small subtriangular spine. Dististyle simple, slightly enlarged near middle, 2 small subapical hairs and about 10 hairs nearer middle. Paraproct short, simple.

Female.—Wing: 3.1–3.8 mm. Torus with a few flat dark scales on inner aspect. Claws of fore and mid legs equal, toothed; claws of hind leg equal, simple. Sternite VIII all brown. *Genitalia* (Fig. 21): Postgenital plate deeply emarginate. Postatrial sclerite wide, very convex, widened laterally. Postatrial plate of characteristic shape. Postatrial hairs fairly long, some of them well removed from median line. Preatrial plates united for most of their length.

Larva.—Unknown.

Biology.—The larvae have been taken in various types of temporary ground pools, including shaded grassy ground pools, a leaf-filled jungle pool, a sunlit rocky pool, and a shaded gravel-bottomed residual pool in a dry stream bed. Adults have been captured biting man during the day in shaded areas.

Distribution.—Specimens have been examined from the following localities in the Philippines: Culion: (Jean Laffoon). Palawan: Puerto Princesa (Jean Laffoon, R. C. McGregor, J. P. Toffaleti); Irahuan River Valley (D. R. Johnson). Balabac: Cape Melville (D. R. Johnson, Jean Laffoon). Previously recorded from the Malay Peninsula and Palawan. Bohart (1945) records this species from Mount Apo, Mindanao, but the specimens on which this identification was based are the types of *nubicolus*.

Remarks.—This species is apparently indistinguishable externally from *macrodixoa* and *nubicolus*. The male genitalia agree well with the figure given by Edwards (1917). As Edwards stated that the male he figured was only arbitrarily associated with the type female of *uncus* and as the female genitalia of the holotype of *uncus* have not been described, it is possible that the present species is not true *uncus*.

Edwards (1913, etc.) has considered *Verrallina malayi* Leicester to be a synonym of *uncus*. Leicester (1908) described *malayi* as having all the claws toothed. This and other characters described by Leicester indicate that *malayi* is not a synonym of *uncus*, but is related to *uniformis* and the other species discussed under *robertsi*. It is possibly synonymous with *fragilis*, as suggested by Leicester in his original description.

Aedes (Aedes) macrodixoa Dyar and Shannon

Aedes (*Aedes*) *macrodixoa* Dyar and Shannon, 1925, p. 77. (Type locality: Infanta, Tayabas, Luzón. Male holotype in U.S.N.M.)

Aedes (*Aedes*) *macrodixoa* Dyar and Shannon, Bohart, 1945, p. 65 and fig. 48 (male only).

Male.—Wing: 2.3–2.8 mm. *Head:* Over 20 verticillate bristles on most antennal segments; torus brown to dark brown ventrally, paler dorsally, bare. Head scales mostly flat, dark brown, a lateral patch of pale flat scales; 2 or 3 pale narrow scales between the eyes, a few pale scales along the eye margin, sometimes a few pale narrow scales along midline, at least 15 dark brown, forked, upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum orange-brown, clothed with golden-brown, narrow, curved scales, black in some lights, paler scales on anterior border of scutum and above the wing base. *Apn* orange-brown to brown, with about 9 bristles, bare. *Ppn* brown, with some narrow curved

scales on the dorsal half similar to those on the scutum, sometimes with a few flat white scales. Pleuron brown. Anterior median portion of sternopleuron with about 10–15 hairs. About 20 bristles along upper margin of mesepimeron, numerous hairs posterior and ventral to the scale patch, extending into the ventral one-fourth of this sclerite. Meteusternum bare. Claws of fore and mid legs unequal, the larger ones toothed, the smaller ones simple; claws of hind legs small, equal, simple. *Abdomen:* Tergites dark brown, II–VIII with basolateral white spots with apices directed dorsoposteriorly, not visible from above. Sternites I–VII almost entirely white, but usually with a few brown scales apically; sternite VIII all white. *Genitalia* (Fig. 12): Basistyle with a conical lobe subapically on the ventrolateral aspect (appearing triangular in flat preparation) with 1 or 2 very heavy bristles apically and several more slender bristles before the tip; dorsad and mesad to this a long process with a single bristle on the outer margin before the middle. On the inner ventral margin near the base a fairly long process with a single bristle on the inner margin before the middle. A short, blunt, nonsclerotized process on the inner aspect close to insertion of dististyle. Dististyle simple, without hairs or bristles. Basistyle with a patch of about 8–12 long bristles near inner dorsal margin, remainder of dorsal aspect without bristles. Sclerotized portion of paraproct very short. Ninth tergite with a very large Y-shaped process posteriorly, each fork with a very hairy ventral branch, main branch smooth dorsally, with a few hairs ventrally.

Female.—Wing: 3.0–3.8 mm. Torus with a few flat dark scales on inner aspect. Claws of fore and mid legs equal, toothed; claws of hind legs equal, simple. Abdominal spots visible from above on segments II–VII. Sternite VIII all brown. *Genitalia* (Fig. 22): Postgenital plate emarginate. Postatrial sclerite wide laterally, narrowed and slightly convex medially. Postatrial plate broadly united with postatrial sclerite, shape characteristic. Postatrial hairs very short, confined to median area. Preatrial plates not united.

Larva.—Unknown.

Biology.—Adults were bred from larvae taken in a temporary leaf-filled pool. The adult has been captured in dense jungle during the day.

Distribution.—Specimens have been examined from the following localities: LUZÓN: Infanta, Tayabas. MINDORO: San José (E. S. Ross). LEYTE: Tacloban (H. R. Roberts). MINDANAO: Mercedes (Jean Laffoon); Parang (J. C. Gregory). The only valid previous record of this species is of the holotype.

Remarks.—This species is apparently indistinguishable externally from *uncus* and *nubicolus*. The female which Bohart (1945) identified and figured as *macrodixoa* has been examined and found to be *dux*. The male figured by Brug (1932) as *macrodixoa* from near the Upper Digoel River in southern Dutch New Guinea is an undescribed species. Additional specimens of this new species from New Guinea are in the National Museum. It differs from *macrodixoa* in the shape and length of the subapical projection of the ventral aspect of the basistyle and in the number of bristles in the patch along the inner dorsal margin of the basistyle (8–12 in *macrodixoa*, 16–22 in the form from New Guinea).

Aedes (Aedes) nigrotarsis (Ludlow)

Pseudoskusea nigrotarsis Ludlow, 1908, p. 52. (Type locality: Infanta, Luzón. Holotype female, U.S.N.M. No. 57979.)
Pseudoskusea mediolineata Ludlow, 1908, p. 332.

Male.—Wing: 2.2–2.6 mm. *Head:* over 20 verticillate bristles on most antennal segments; torus dark brown, with a few tiny, rather narrow, dark scales medially. Head scales mostly flat dark brown, a lateral patch of flat pale scales, sometimes 2 or 3 pale narrow curved scales behind eye margin, sometimes a few narrow pale scales along midline, 20 or more forked upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum blackish brown, clothed with golden-brown, narrow, curved scales, black in some lights. *Apn* with about 8 large bristles and some smaller ones, without scales. *Ppn* with a few light-brown, narrow, curved scales on the dorsal half. Pleuron dark brown. Anterior median portion of sternopleuron bare. A number of bristles along the upper border of the mesepimeron, sometimes up to 3 or 4 small hairs behind scale patch, always bare below. Claws on fore and mid legs unequal, the larger ones toothed, the smaller ones simple; claws on hind leg small, equal, simple. *Abdomen:* Tergites dark brown with basolateral white patches

with apices directed dorsoposteriorly, usually not visible from above, sometimes barely produced onto dorsum of segments VI and VII. Sternites II–VII brown, sternite VIII pale. *Genitalia* (Fig. 5): Basistyle with a very broad rectangular apical prolongation. Ventral margin with a triangular process near base. Dististyle slender, curved, with a short subapical hair and 2 short hairs arising from a short projection well beyond middle. Paraproct long, simple.

Female.—Wing: 2.5–3.0 mm. Torus with a few flat dark scales medially. Claws of fore and mid legs equal; toothed; claws of hind leg equal, simple. Tergites II–VII with lateral spots usually produced onto dorsum to form complete or nearly complete subbasal transverse white or yellowish bands. Sternite VIII brown. *Genitalia* (Fig. 20): Postgenital plate slightly emarginate, narrow. Postatrial sclerite very convex, very wide posteriorly and laterally. Postatrial area with several sclerotized areas and a large number of long hair-like processes with numerous branches, apparently anastomosing. A large, rounded, unpaired, very darkly pigmented preatrial plate, anterior to this a pair of smaller plates.

Larva (Fig. 28).—*Head:* Antenna uniformly light brown; head hair 11 with 2–5 feebly plumose branches, inserted before middle of shaft. Head hair 4 very small, with 4–6 branches; head hairs 5 and 6 with 3 branches (sometimes 2), the median branch always distinctly stouter and longer than the lateral branches; hair 7 with 7–11 branches; 8 with 2–4; 9 with 3–6; 14 with 2–5. Mentum with 16–19 teeth on each side. *Abdomen:* Hair 6 of segment I with 3–4 branches; hair 7 of segment I double; hair 6 of segment II with 2–4 branches; hair 6 of segments III–VI single, sometimes one or more double. Comb scales with a distinct terminal spine and a fine lateral fringe, 8–11 in number. Pentad hair 1 with 3–5 branches, 2 with 2–3, 3 with 7–13, 4 single, 5 with 8–12. Siphonal index about 2.0; hair tuft 2–6-branched; 8–14 pecten teeth, distal tooth inserted beyond middle; basal teeth with 1–3 lateral denticles; distal 2–5 teeth usually with only one very small lateral denticle; dorsal side of spines usually bare, occasionally with one or more denticles; distal 1–3 teeth more widely spaced than those nearer base. *Isc* 7–11-branched; *lh* single, about half as long as anal plate; ventral brush with about 14 tufts; anal gills lanceolate, pointed, dorsal pair 1.7–2.2 times the length of the anal plate, ventral pair slightly shorter.

Biology.—The larvae were taken several times in temporary grassy pools. Adults have been captured in light traps.

Distribution.—Specimens have been examined from the following localities: LUZÓN: Infanta; Subic Bay (E. S. Zolik); Camp Nichols, Rizal (Pvts. Carraway, Sinclair, and Williams); Calauan and Quezon City (F. E. Baisas); Wackwack and Manila (Harry Hoogstraal). SAMAR: Osmena (Jean Laffoon, L. E. Rozeboom). JINAMOC ISLAND (near Basey, Samar): (J. T. Medler). LEYTE: Tacloban (H. R. Roberts); Abuyog (O. H. Graham). MINDANAO: Zamboanga and San Ramón (K. L. Knight, Jean Laffoon). The species has previously been recorded only from Luzón.

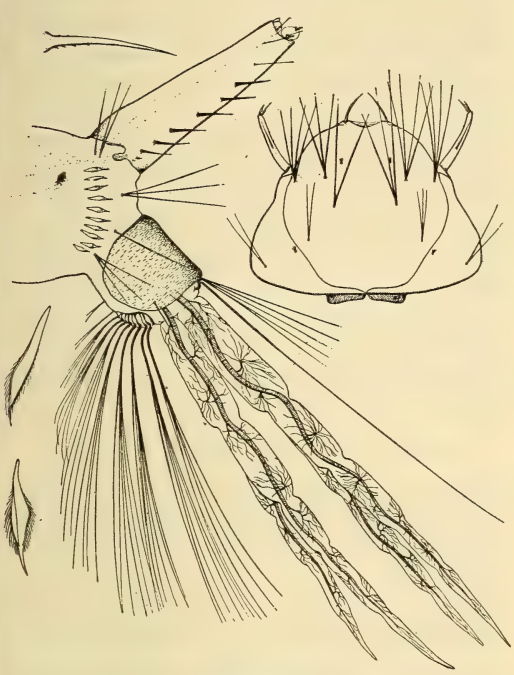
Remarks.—Dyar and Shannon (1925) stated that many of the smaller specimens of *nigrotarsis* lack abdominal spots. The entire collection of this species in the National Museum was examined for this character, and it was found that all specimens that had previously been identified as *nigrotarsis* (probably by Dyar and Shannon) and that were lacking abdominal spots were actually *dux*.

This species is closely related to *indicus* (Theobald). As pointed out Bohart (1945), the ventral process near the base of the basistyle is triangular in *nigrotarsis* but long and slender in *indicus*. A female of *indicus* from India was examined and the genitalia were found to apparently differ from *nigrotarsis* in not having the hairlike processes arising as far posteriorly as in *nigrotarsis* and in having a narrow longitudinal slit through most of the length of the unpaired preatrial plate.

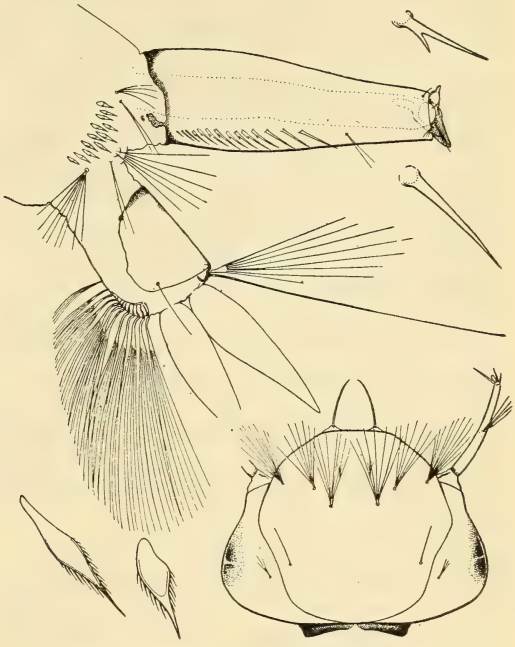
Aedes (Aedes) campylostylus, n. sp.

Male.—Wing: 2.2–2.9 mm. *Head:* Over 20 verticillate bristles on most antennal segments; torus yellowish brown dorsally, remainder dark brown, bare or with a few flat dark scales medially. Head scales mostly flat, dark brown, a lateral patch of flat, white scales, a few pale scales along eye margin and between the eyes, sometimes a few pale scales along the midline, about 30 dark-brown, forked, upright scales on the nape of each side of the midline. *Thorax:*

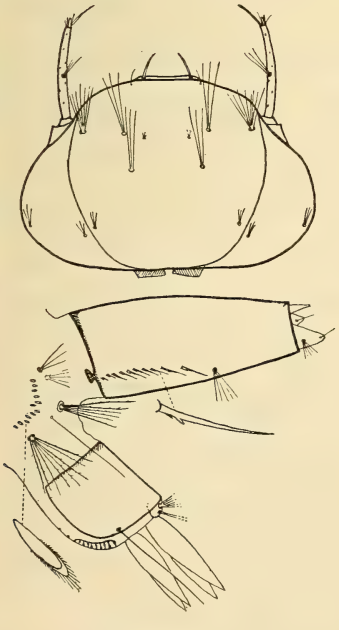
Integument of scutum and scutellum dark reddish brown, clothed with golden-brown, narrow, curved scales, black in some lights. *Apn* reddish brown, with about 9 bristles, often with a few pale, flat scales. *Ppn* reddish brown with a few narrow, curved scales on the dorsal half similar to those on the scutum. Pleuron reddish brown. Anterior median portion of



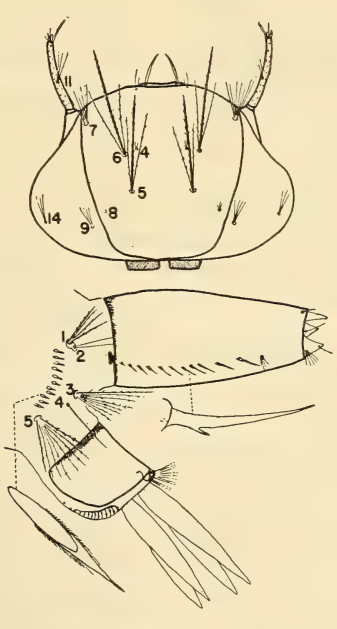
25. hamistylus



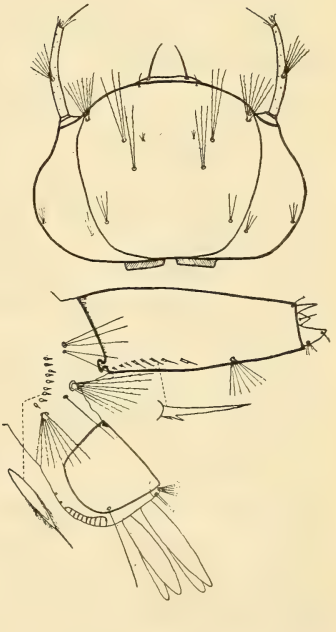
26. campylostylus



27. umbrosus



28. nigrotarsis



29. dux

FIGS. 25–29.—Larvae.

sternopleuron bare. About 8 pale upper mesepimeral bristles, posterior and ventral parts of mesepimeron without hairs or with up to about 4 posterior to the scale patch. Meteusternum bare. Claws of fore and mid legs unequal, the larger ones with a large tooth, the smaller ones with a small tooth; claws of hind legs small, equal, simple. *Abdomen:* Tergites dark brown, II–VIII with basolateral white spots with apices directed dorsoposteriorly, sometimes barely visible from above. Sternites I–VII white basally, pale brown on apical one-third; sternite VIII completely white. *Genitalia* (Fig. 13): Basistyle with a long bladelike process apically, ventral to this a dense patch of long, heavy bristles. Ventral margin with a subtriangular projection near base, near base of this a sclerotized triangular projection with a smaller nipplelike projection arising from its dorsal side near base. Dististyle subapical, curved, with 3 hairs near middle. Paraproct very long, with a short branch arising near middle.

Female.—Wing: 2.9–3.5 mm. Torus with a few rather narrow small dark scales medially. Claws of fore and mid legs equal, toothed; claws of hind legs equal, simple. Abdominal spots visible from above on segments II–VIII. *Genitalia* (Fig. 24): Postgenital plate emarginate. Postatrial sclerite wide, convex, almost evenly rounded. Postatrial plate with a very characteristic posterior arm. Postatrial hairs fairly short, confined to median area. Preatrial plates not united.

Larva (Fig. 26).—Very similar to *margarsen* and *johnsoni* except as follows: Mentum with 18–20 lateral teeth (average of 24 cases, 18.9). Prothoracic hair 2 single (in all of 25 cases); hair 8 double (in all of 23 cases). Siphon with 11–17 pecten teeth. Anal gills 1.8–3.2 times length of anal plate.

Holotype.—Male, with associated larval and pupal skins, U.S.N.M. No. 57977, from about 4 miles inland along Balsahan River, Palawan (near Iwahig), June 13, 1945, collected in a rock hole along river (A. T. Fitzjarrell).

Paratypes.—Thirty-two males, 27 females, 5 whole larvae, 9 larval skins (6 associated with adults); 6 pupal skins (5 associated with adults). PALAWAN: Balsahan and Irahuan River Valleys, June 1945 (D. R. Johnson, A. T. Fitzjarrell, Jean Laffoon). MINDORO: San José, April and May 1945 (E. S. Ross). BALABAC: Cape Melville, June 1945 (A. T. Fitzjarrell, D. R. Johnson, Jean Laffoon). LEYTE: Tacloban, September 1945 (H. R. Roberts). MINDANAO: San Ramón, September 1945 (D. R. Johnson, K. L. Knight, Jean Laffoon). Deposited in U. S. National Museum, British Museum, Academy of Natural Sciences of Philadelphia, and California Academy of Sciences.

Biology.—Larvae have been taken in rock holes (twice); a tin can containing clear water and some leaves (once); gravel-bottomed residual pools in dry stream beds (twice); in a shaded, rocky overflow pool close to a stream (once), and in temporary road rut pools (once). This species apparently prefers jungle habitats.

Remarks.—The genitalia of both sexes are different from any others that have been described in this subgenus.

Aedes (Aedes) panayensis Ludlow

Aedes panayensis Ludlow, 1914, p. 159. (Type locality: Iloilo, Panay. Male lectotype, U.S.N.M. No. 57978, here designated from 49 cotypes in U.S.N.M.)

Male.—Wing: 2.7–3.1 mm. *Head:* About 12 verticillate bristles on most antennal segments; torus yellowish brown dorsally, remainder dark brown, with a few dark scales medially. Head scales mostly flat, dark brown, a lateral patch of flat white scales, a few pale scales along eye margin and between the eyes, sometimes 2 or 3 narrow pale scales along midline, about 12 dark brown, forked, upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum dark reddish brown, clothed with golden-brown, narrow, curved scales, black in some lights. *Apn* brown with about 8 bristles and a few pale flat scales. *Ppn* brown with a number of narrow scales on the dorsal half similar to those on the scutum. Pleuron brown. Anterior median portion of sternopleuron without hairs, scales of upper sternopleural patch usually extending to anterior median angle of sclerite. About 10 pale upper mesepimeral bristles and about 15–20 hairs on the posterior and ventral parts of the sclerite, extending nearly to the ventral edge. Meteusternum bare. Claws of fore and mid legs equal, toothed; claws of hind leg equal, simple. *Abdomen:* Tergites dark brown, tergites II–VIII with white basolateral spots with apices directed dorsoposteriorly, sometimes

barely visible from above. Sternites I–VII with a wide basal band of pale scales, covering at least the basal one-half, remainder brown; sternite VIII with brown and white scales. *Genitalia* (Fig. 4): Basistyle with 3–4 very strong bristles in a row close to the inner dorsal margin; apically a broad flattened process directed mesad; on the inner ventral surface near the base a fairly long slightly curved process. Dististyle subapical, a fairly stout bristle and about 5 hairs near the middle.

Female.—Wing: 2.2–2.5 mm. Torus with a few flat dark scales medially. Claws of fore and mid legs equal, toothed; claws of hind leg equal, simple. Sternite VIII brown. *Genitalia* (Fig. 18): Postgenital plate emarginate. Postatrial sclerite nearly straight posteriorly, weak medially. Apparently no postatrial hairs. Preatrial plates with numerous short hairs, broadly but weakly united medially.

Larva.—Unknown.

Biology.—This species is apparently confined to coastal areas. The larvae have been taken in slightly brackish water in a beached canoe and in a shaded, leafy, slightly brackish puddle in a nipa palm swamp at the extreme upper limit of the tidal zone. The adults have been captured biting man in mangrove swamps in the daytime and resting in a crab hole in a mangrove swamp.

Distribution.—Specimens have been examined from the following localities: PANAY: Iloilo (Major Ewing). CALICOAN ISLAND (near Guiuan, Samar): (J. H. Paullus). CULION: (Jean Laffoon). BALABAC: Cape Melville (D. R. Johnson), MINDANAO: Zamboanga (K. L. Knight). MOROTAI: Point Gila (K. L. Knight). SCHOUTEN ISLANDS, DUTCH NEW GUINEA: Aioki Island in Padaido Group (A. G. Humes). Bohart (1945) recorded this species from Manila, Luzón, but this record was based on a misidentification. Dyar and Shannon (1925) and Bohart (1945) recorded it from Jolo Jolo, but this record is in error.

Remarks.—In her description Ludlow failed to designate types. However, she stated that this species is "rather widespread, but the first specimens were taken at Iloilo, Panay, P.I. Taken at various times in the various places." Dyar and Shannon (1925) stated, "Out of a very large series bred at one time by Major Ewing at Jola Jola, 49 specimens were found in a bottle labelled types." The 49 specimens mentioned are still in the National Museum. Only one bears any label in addition to the type label; this one reads, in what is presumably Ludlow's handwriting: "*Skusea multiplex* Theo. Iloilo, Panay, P.I. Ewing." The name was later crossed out and "*Aedes panayensis* Ludl. Types" added to the label. It is apparent that Dyar and Shannon misread Ludlow's label and that the specimens were from Panay. There are a large number of other specimens (not types) in the Museum, some entirely without labels and some labeled "Jola Jola, Ewing." The latter were probably incorrectly labelled by Dyar, as they have the same misspelling. The only reliable record in the literature, therefore, is for Panay and includes the type series only.

The claws of the fore and mid legs of the male of this species differ from all other males in this subgenus for which the claws have been described in being equal and toothed. The closest relatives appear to be *dermajoensis* Brug and *prioekanensis* Brug, on the basis of the figures of the male genitalia given for those species by Brug (1931). Both are known only from Sumatra.

Aedes (Aedes) umbrosus Brug

Aedes (*Skusea*) *umbrosus* Brug, 1924, p. 437. (Type locality: Undesignated, Tanah Grogot, southeastern Borneo (3 males and 2 females), or Weltevreden, Java (1 male). Types: 4 males and 2 females in British Museum.)

Male.—Wing: 2.0–2.4 mm. *Head:* About 20 verticillate bristles on most antennal segments; torus dark brown. Head scales mostly flat dark brown, a lateral transverse line of flat white scales, a few pale narrow scales between the eyes, sometimes a few pale narrow curved scales on each side of midline, a number of dark brown, forked, upright scales on nape on each side of midline. *Thorax:* Integument of scutum and scutellum blackish brown, clothed with golden-brown, narrow, curved scales, black in some lights, paler scales on anterior border of scutum and above the wing base. *Apn* dark brown, without scales, with about 6 large and 6 small bristles. *Ppn* dark brown, bare or with a few narrow curved scales on the dorsal half similar to those on the scutum. Pleuron brown. Anterior median portion of sternopleuron usually bare, occasionally with up to about 8 very small hairs. About 10 upper mesepimeral

bristles and always at least 10 hairs posterior and ventral to the scale patch, often much more numerous. Meteusternum bare. Claws of forelegs unequal, both toothed; claws of mid legs unequal, both simple; claws of hind legs small, equal, simple. *Abdomen:* Tergites dark brown, II–VIII with basolateral white spots with apices directed dorsoposteriorly, not visible from above. Sternites entirely dark brown, or with a variable number of white scales on the basal one-third only. *Genitalia* (Fig. 1): Basistyle short and broad, numerous scales basally on the dorsal aspect, but no bristles. Two very heavy proximated subapical dorsal spines, a shorter one basal to these, with a much shorter one basal to it. Dististyle inserted near middle, with a wide basal lobe, deeply forked, with about 9 bristles on the enlarged basal portion, 3 near the fork, and 2 very small spines and 2 very small hairs near the apex. Paraproct rather short.

Female.—Wing: 2.5–3.0 mm. Torus with a few dark flat scales on the median aspect. Claws on fore and mid legs equal, toothed; claws of hind leg equal, simple. *Genitalia* (Fig. 17): Postgenital plate rounded or barely emarginate. Postatrial sclerite slightly convex medially with nearly square posterolateral corners, giving a trilobed appearance to the posterior margin. Postatrial hairs short, preatrial plates rounded, broadly disjoined, with numerous short hairs.

Larva (Fig. 27).—*Head:* Hair 11 with 4–8 branches, inserted before middle of shaft; 4 very small, with 3–5 branches; 5 with 3–4; 6 with 2–4; 7 with 6–9; 8 with 3–6; 9 with 2–4; 14 with 2–5. Mentum with 11–13 lateral teeth. *Abdomen:* Hair 6 of segment I with 2–3 branches; hair 7 of segment I with 1–2 branches; hair 6 of segment II double; hair 6 of segments III–VI single. Comb scales with a complete apical fringe, no prominent terminal spine, 9–14 in number. Pentad hair 1 of segment VIII with 3–5 branches; 2 with 4–5; 3 with 6–11; 4 single; 5 with 8–14. Siphonal index 2.4–3.0; hair tuft 5–8-branched; 7–12 pecten teeth, distal tooth usually inserted before middle, sometimes just beyond, all teeth usually having a well-formed lateral denticle, tending to be somewhat smaller on the distal teeth, sometimes 3 or 4 lateral denticles, distal 1–2 teeth sometimes somewhat more widely spaced than those nearer base. *Isc* with 6–10 branches; *lh* single, at least as long as anal plate; ventral brush with about 12 tufts, the anterior two 1–5-branched, the remainder with 6–12 branches. Anal gills lanceolate, 0.8–1.5 times as long as anal plate.

Biology.—This species is probably never found far from the ocean, as all records are from coastal areas. Adults have been reared from larvae taken in a slightly brackish, shaded, leaf-filled puddle in a nipa palm swamp at the extreme upper limit of the tidal zone and in temporary, shaded, fresh-water, leaf-filled ground pools. Females have been captured biting during the day in a mangrove swamp. Edwards and Given (1928) report the larvae in "potholes and crab-holes in uncut mangrove."

Distribution.—Specimens have been examined from the following localities: LEYTE: Tacloban and Palo (H. R. Roberts). CULION: (Jean Laffoon). PALAWAN: Iwahig and Puerto Princesa (D. R. Johnson and Jean Laffoon). DUTCH BORNEO: Tarakan Island (off east coast of Borneo) (A. G. Humes). The species has previously been recorded from Dutch Borneo, Java, and Singapore.

Remarks.—This species may possibly be a synonym of *butleri* (Theobald), as it appears that the male which has been assigned to *butleri* does not belong to that species, but to *lugubris* Barraud, as indicated by the following facts:

In the original descriptions of *butleri* and *diurna* (Theobald) (which has been synonymized with *butleri*). Theobald (1901 and 1903) stated that their abdomens have basolateral spots but no transverse bands. Barraud (1928 and 1934) stated that *lugubris* (of which he had no males) has a narrow transverse white band on the second abdominal segment. There are two females in the National Museum that have this character and that agree well with Barraud's figure of the female genitalia of *lugubris*. As one of these specimens was taken as a larva along with two males and as the females agree well in external characters with the males, they are almost certainly one species. All four specimens were collected on the Malay Peninsula by Leicester and identified by Edwards in 1912 as *butleri*. The males are cospecific with the male described and figured by Edwards in Barraud (1934) as the male of *butleri*. Since the females examined are apparently cospecific with *lugubris*, this male is therefore *lugubris*,

unless Theobald failed to note the band on the second abdominal segment in the type of *butleri*, in which case *lugubris* is probably a synonym of *butleri*.

If the male considered here to be *lugubris* is not *butleri*, it is possible that *umbrosus* is a synonym of *butleri*, as there is nothing in the descriptions of *butleri* or *diurna* to exclude it and as both *butleri* and *umbrosus* are recorded from Malaya. Furthermore, Barraud described and figured the female genitalia of *butleri* from India, and his figure and descriptions agree well with the specimens here considered *umbrosus*.

Edwards (1913) made *Stegomyia hatiensis* Carter (known from females only) a synonym of *butleri*. In his original description of this species, Carter (1910) stated that the scutellum of *hatiensis* has "scales similar to those covering the greater part of the head," which would imply that the scutellar scales are flat. If this is true, *hatiensis* does not belong in this subgenus, and is probably a *Skusea*.

These questions can not be satisfactorily settled until the genitalia of the type females of *butleri*, *diurna*, and *hatiensis* have been studied.

The species considered *umbrosus* in this paper can be separated from the four specimens mentioned as having been identified by Edwards as *butleri*, but which are probably *lugubris*, by the male and female genitalia, by the absence of a narrow transverse subbasal white band on the second abdominal segment of the female of *umbrosus* and its presence in the other species, and by the extent of the hairy area of the lower part of the mesepimeron (usually extending below the scale patch in *umbrosus*, confined to a posterior row behind the scale patch in *butleri*).

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ZOOLOGY.—*Capt. M. S. Briscoe's collection of reptiles and amphibians from Harbel, Liberia.*[1] ARTHUR LOVERIDGE. (Communicated by HERBERT FRIEDMANN.)

Through the courtesy of Dr. Doris M. Cochran, I have been able to examine the herpetological collection made by Capt. M. S. Briscoe, part of which was presented by him to the United States National Museum, part to the Museum of Comparative Zoology, and the remainder to Howard University. The collection contains a very large example of *Thrasops occidentalis*, the only specimen of this rare tree snake in any museum in the United States. There are no fewer than ten other species of snakes not taken at Harbel by the Smithsonian-Firestone Expedition of 1940, which collected there. Captain Briscoe is to be congratulated on taking advantage of this opportunity to extend our knowledge of the herpetofauna of the Republic of Liberia.

LIZARDS

Varanus niloticus ornatus (Daudin)

1803. *Tupinambis ornatus* Daudin, Hist. Nat. Rept. 8: 353; Malimbe, Cameroon (restricted by Mertens).

juv. (U.S.N.M. 122266)

[1] Received April 8, 1946.

This 360 (135+225) mm monitor, having five transverse rows of spots between fore and hind limbs, conforms to this race as defined by Mertens (Abh. Senckenberg. Naturf. Ges., No. 466:320. 1942) in his recent revision of the family. *V. n. ornatus* is the sylvicoline race, with the typical form occupying the savanna regions of Liberia.

Mabuya blandingii (Hallowell)

1844. *Euprepes blandingii* Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1844: 58; Liberia.

1 (U.S.N.M. 122267)

Quite typical of Blanding's skink, of which *frenatus* (Hallowell) is a synonym. Length 185 (75+110) mm.

SNAKES

Calabaria reinhardtii (Schlegel)

1848. *Eryx reinhardtii* Schlegel, Bijdr. Dierk. 1: 3, pl. —; Gold Coast.

♂♂ (M.C.Z. 49014; Howard Univ.)

Midbody scalerows 30–32; ventrals 222 (in both); anal 1; subcaudals 23 (in both); 2 superposed loreals, except on left side of U.S.N.M. 122226; preocular 1, except on left side of M.C.Z. 49014, where there are 2. Larger ♂ 870 (800+70) mm.

Natrix anoscopus anoscopus (Cope)

1861. *Tropidonotus anoscopus* Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861: 299; "Cuba" (error, probably Liberia).

♂♀♀♀ (U.S.N.M. 122237; M.C.Z. 49015; Howard Univ.)

Midbody scalerows 23–25; ventrals 138–141; anals 2; subcaudals 64–71; preoculars 1–2; postoculars 1–2; suboculars 3. Largest ♀ 565 (425+140) mm.

Boaedon lineatus lineatus
Duméril and Bibron

1854. *Boaedon lineatus* Duméril and Bibron, Erpétologie générale 7: 363; Gold Coast.

♀♀♀ (U.S.N.M. 12233; Howard Univ.)

Midbody scalerows 29–32; ventrals 216–220; anal 1; subcaudals 50–54; preoculars 2; postoculars 2; temporals 1+2, rarely 1+1. Largest ♀ 779 (680+99) mm.

Boaedon lineatus virgatus (Hallowell)

1854. *Coelopeltis virgata* Hallowell, Proc. Acad. Nat. Sci. Philadelphia 1854: 98; Liberia.

♂ (Howard Univ.)

Midbody scalerows 21; ventrals 60; anal 1; subcaudals 60; preocular 1; postoculars 2; temporals 1+1. Length 360 (305+55) mm.

I have previously recorded both races of the house snake from Liberia; now it appears that both may occur in the same locality. The typical form is a savanna reptile, while *virgatus* with its gray-flanked ventrals and gray subcaudals is a sylvicoline race. This arrangement is paralleled in the Republic by other species like the savanna *Varanus n. niloticus* and its forest-dwelling form *V. n. ornatus*.

Thrasops occidentalis Parker

1940. *Thrasops occidentalis* Parker, Ann. Mag. Nat. Hist., ser. 11, 5: 273, figs. 1 and 2a; Axim, Gold Coast.

♀ (U.S.N.M. 122257)

Midbody scalerows 15; ventrals 187; anals 2; subcaudals 132; labials 8, fourth and fifth entering orbit; preocular 1; postoculars 3; loreal 1; temporals 1+1. Length 1565 (1115+450) mm.

The occurrence of this rare species in Liberia was previously known only from a paratype male from Monrovia. This, the second known female, is not only the largest example known, but is the first of its species to reach any museum in the United States.

Since my revision of the genus *Thrasops* (Bull. Mus. Comp. Zoöl. 95: 121–247. 1944) C. M. Bogert has invited my attention to the fact that *Ahaetulla occidentalis* Günther, 1859, was erroneously placed in the genus *Thrasops* by Cope, 1860. As this is a secondary homonym it in no way invalidates Parker's use of the name in *Thrasops*.

Boiga pulverulenta (Fischer)

1856. *Dipsas pulverulenta* Fischer, Abh. Geb. Naturw. Hamburg 3: 81, pl. 3, figs. 1a–1c; Edina, Grand Bassa County, Liberia.

♂ (U.S.N.M. 122230)

Midbody scalerows 19; ventrals 260; anal 1; subcaudals 132; preocular 1; postoculars 2; temporals 2+2. Length 912 (720+192) mm.

Boiga blandingii (Hallowell)

1844. *Dipsas Blandingii* Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1844: 170; Liberia.

♂ (U.S.N.M. 122255)

Midbody scalerows 23; ventrals 273; anals 2; subcaudals ?; preoculars 2; postoculars 2; temporals 2+2. Length 1973+ (1730+243+) mm.

This is an exceptionally large example, for Blanding's tree snake rarely exceeds 6 feet.

Psammophis sibilans phillipsii (Hallowell)

1844. *Coluber Phillipsii* Hallowell, Proc. Acad. Nat. Sci. Philadelphia 1844: 169; Liberia.

♂♂ ♀ ♀ (U.S.N.M. 122253; M.C.Z. 49016; Howard Univ.)

Midbody scalerows 17; ventrals 161–175; anal 1; subcaudals 91–97; labials 8, 4th and 5th entering orbit; nasals 2–3; preocular 1; postoculars 2; temporals 2+2 or 2+3. Largest ♀ 1262 (880+382) mm.

Thelotornis kirtlandii kirtlandii (Hallowell)

1844. *Leptophis Kirtlandii* Hallowell, Proc. Acad. Nat. Sci. Philadelphia 1844: 62; Liberia.

juv. (Howard Univ.)

Midbody scalerows 19; ventrals 174; anals 2; subcaudals 154; preocular 1; postoculars 3; temporals 1+2. Length 632 (395+237) mm.

Miodon acanthias (Reinhardt)

1860. *Urobelus acanthias* Reinhardt, Vid. Medd. Kjøbenhavn 1860: 229, pl. 3; Guinea.

juv. (U.S.N.M. 122250)

Midbody scalerows 15; ventrals 188; anal 1; subcaudals 22; preocular 1; postoculars 2; temporals 1+1. Length 186 (170+16) mm. Almost certainly a male, this is about the tenth known example of the species.

Aparallactus modestus (Günther)

1859. *Elapops modestus* Günther, Ann. Mag. Nat. Hist., ser. 3, **4**: 161, pl. 4, fig. C; West Africa.

♂ ♀ (U.S.N.M. 122229; Howard Univ.)

Midbody scalerows 15; ventrals 143–160; anal 1; subcaudals ?; preocular 1; postoculars 2; temporal 1. Length ?, as tails truncate.

Dendroaspis viridis (Hallowell)

1844. *Leptophis viridis* Hallowell, Proc. Acad. Nat. Sci. Philadelphia 1844: 172; Liberia.

♂♂ (M.C.Z. 49017; Howard Univ.)

Midbody scalerows 13; ventrals 213–218; anals 2; subcaudals 112–118; preoculars 2+1; subocular; postoculars 3+1 or 0 subocular; lower temporal absent in one specimen, having fused with the labial. Larger ♂, 1760 (1305+455) mm.

Causus rhombeatus (Lichtenstein)

1823. *Sepedon rhombeatus* Lichtenstein, Verz. Doubl. zool. Mus. Berlin 1823: 106; no type locality.

7♂♂, 3♀♀ (U.S.N.M. 122245–48; Howard Univ.)

Midbody scalerows 19; ventrals 121–137; anal 1; subcaudals 17–22; mostly paired; preoculars 2; postoculars 2; suboculars 1–3; temporals 2+3. Largest ♂, 443 (400+43) mm, and ♀ 431 (395+36) mm.

The rhombic night adder, so common in Liberia, supplied the motif for the pattern on an armlet, worked in black and yellow grass, brought back in 1944 by Dr. J. C. Bequaert from a village near Kolahun, Republic of Liberia.

Bitis gabonica (Duméril and Bibron)

1854. *Echidna Gabonica* Duméril and Bibron, Erpétologie générale **7**: 1428, pl. 80B; Gaboon.

Head and skin (Howard Univ.)

Midbody scalerows 35; ventrals 132; anal 1; subcaudals 19; upper labials 14–14. A fine large example of the Gaboon viper.

Atheris chloroechis (Schlegel)

1855. *Vipera chloroechis* Schlegel, Versl. Akad. Amsterdam **3**: 317.

♀ (Howard Univ.)

Midbody scalerows 29; ventrals 157; anal 1; subcaudals 58; interorbitals 10+2 circumorbitals; circumorbitals 18–19; upper labials 11. Length 390 (330+60) mm.

AMPHIBIA

Geotrypetes seraphini occidentalis Parker

1936. *Geotrypetes seraphini occidentalis* Parker, Zool. Meded. **19**: 99; Grand Cape Mountain, Liberia, etc.

1 (U.S.N.M. 122261)

This well-preserved caecilian has 102 primary and apparently 38 secondary folds. In the latter respect it does not conform to Parker's definition of the western race. Length 290 (289+2) mm.

Rana occipitalis Günther

1858. *Rana occipitalis* Günther, Cat. Batr. Sal. Brit. Mus.: 130, pl. 11; Gambia (restricted).

3 juv. (U.S.N.M. 122262–3; M.C.Z. 26136)

Ranging in head and body length from 33–40 mm, these are the smallest bullfrogs of this species I have seen. As they lack the characteristic transverse occipital fold connecting the posterior corners of the orbits, they fail to

conform to the key I devised (1941, pp. 13–4 135) to differentiate the nine members of the genus *Rana* found in the Republic of Liberia.

Megalixalus fulvovittatus (Cope)

1860. *Hyperolius fulvovittatus* Cope, Proc. Acad. Nat. Sci. Phila. 1860: 517; Liberia.

♀ (U.S.N.M. 122265)

This 26-mm striped sedge frog is quite typical of the species, with which I have synonymized *Hyperolius vittiger* (Peters).

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Obituary

GLENN LANE PARKER died suddenly at his home on February 12, 1946, having worked during the forenoon of that day at his office in the U. S. Geological Survey. He was born on December 23, 1884, in the small mining town of Wickes, near Butte, Mont., received his early education in the public schools of Kansas, was graduated in civil engineering by the University of Kansas in 1906, and continued in graduate work at that institution until June 1908. Shortly thereafter he entered the Federal service as deck officer in the U. S. Coast and Geodetic Survey, from which he was transferred on January 1, 1909, to water investigations in the Geological Survey in which he spent the rest of his life. He served first in the Seward Peninsula, and later in the Yukon-Tanana region of Alaska. In April 1911 he was assigned to the Survey's Columbia River district, and in March 1913 he was made district engineer for the State of Washington with headquarters in Tacoma, where he filled this position until October 1939 when he was made chief of the Survey's Water Resources Branch and was transferred to Washington, D. C. He continued in the latter position until his death.

During the 26-year term of service as district engineer in the State of Washington, Mr. Parker became known as an outstanding authority in national and international problems related to the quantity, control, and utility of the waters of the Columbia River Basin. In the following six years, when he was chief of the Water Resources Branch, he served as adviser of the International Joint Commission on problems related not only to the waters of the Columbia River Basin but also to those of the whole Canadian boundary. He served with a Canadian engineer as a two-man board to divide the waters of the Milk and St. Mary Rivers, in accordance with a rule adopted by the International Joint Commission. Since 1944 he served as a member of the International Columbia River Engineering Board, which is investigating the international features of the utilization of the waters of Columbia River. He was active in the studies of water utilization in connection with the recently executed treaty with Mexico which provided for the equitable division of the waters of the Rio Grande and of the Colorado and Tia Juana Rivers between the United States and Mexico. He was appointed by President Roosevelt as the United States representative on the Republican River Compact Commission and in that capacity was active in drafting the compact between the States of Colorado, Kansas, and Nebraska for the division and control of the waters of the Republican River Basin.

He was author or joint author of many reports on the Nation's water resources, especially those of the Pacific Northwest and Alaska. He was a member of American Society of Civil Engineers and was active in its affairs, having served in important committee assignments and as a director during 1939 and 1940.

On December 16, 1914, he married Grace Imogene Guy, of Washington, D. C., who survives him. Their only son, Lt. (jg) Glenn Guy Parker, who enlisted in the Navy on his graduation from Stanford University in 1941 and became a dive-bomber pilot, was killed on December 27, 1943, by the crash in the Southwest Pacific of a transport plane on which he was a passenger.

Mr. Parker was a hard and efficient worker, a keen analyst of great technical ability, and a cooperative leader in his fields of activity and interest. He became, therefore, a great producer of valuable results in the investigation of the Nation's invaluable water resources. His record of accomplishment is his enduring monument.

CARL G. PAULSEN

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ETHNOLOGY.—*Bird nomenclature and song interpretation of the Canadian Delaware: An essay in ethno-ornithology.*[1] FRANK G. SPECK, University of Pennsylvania. (Communicated by HERBERT FRIEDMANN.)

This study is offered as an incentive to ornithologists and ethnologists concerned with the topic of bird life in its broadest sense.

To this end an attempt is made here to show the extent of notions possessed by the Canadian survivors of Indians constituting the Delaware Nation, whose earlier historic habitat was in the latitude of the Middle Atlantic Slope. It would accordingly not be easy to draw definite conclusions as to the regions in the East where the elements of Delaware birdlore were endemic. The Delaware have dwelt in Ontario for a century and a half. This makes it possible that their knowledge may be derived from bird observations in that locality. Or it may, on the other hand, refer to the regions whence the tribes once migrated.

We are aware that the question as to the quality of appreciation of nature among uncivilized people has long been an open one. One may assume obstinately that artificial sentiments toward nature transmitted in European tradition, in poetry, and in contemplative literature of the pastoral and reflective type come only from the writings of the nature dreamers.[2] It is, therefore, not easy for many to decide whether nature literature, purely oral of course, existed at all among preliterate peoples, for it has not been given attention by early observers who described their life ways. It is only European writers who have left accounts of native beliefs and notions, and they seldom gained insight into native feelings and cogitations regarding nature intimately enough to treat the matter subjectively. In short, whereas the growth of nature thought is preserved for us in written records, for that of aboriginal peoples we are dependent upon tradition handed down by word of mouth.

Now, however, the field takes on a wider horizon, one that must include tribes of so-called uncivilized levels whose attitude toward nature was not affected by the European aesthetic tradition. Boas thought nature appreciation to be a universal trait, observing as follows. "Aesthetic pleasure is felt by all members of mankind. No matter how diverse the ideals of beauty may be, the general character of the enjoyment of beauty is of the same order everywhere."[3]

If the Delaware Indian confides to his companion that the roar of the wind swishing through the summits of pines is the voice of the trees giving devotion to the Creator, if the Naskapi of Labrador whispers to us that when the trees on the hillside bend under the force of the wind it is the hand of the Supreme Being combing the hair of his children, should such thoughts not be placed alongside the exalted voice of Isaiah who proclaimed: "The mountains and the hills shall break forth before you into singing, and all the trees of the field shall clap their hands." However, the theme now before us revolves about

[1] Received May 3, 1946.

[2] An interesting and thought-provoking dissertation surveying the background of these ideas is given by PHILIP MARSHALL HICKS, *The development of the natural history essay in American literature*, Philadelphia, 1924. See also *Nature in American literature*, by NORMAN FOERSTER, New York, 1923.

[3] FRANZ BOAS, *Primitive art*, Instituttet for Sammenlignende Kulturforskning, Oslo, 1927, p. 9.

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birds, not trees. It deals with the casual bird-mindedness not of early man in general but of a small group of Indians in Canada, the Algonkian-speaking Delawares, and explores entirely new fields of thought and observation in natural history for which there is, as yet, no system of orthodox investigation. A short historical review of the people's past is apropos.

Almost two centuries have passed since the historically famous bands of the Delaware Nation departed from their original haunts in the valleys of the Delaware and Hudson Rivers and their tributaries in New Jersey, eastern Pennsylvania, and eastern New York State. Through vicissitudes of the earlier century of alternating peace and strife with Dutch, Swedish, and English administrators and colonists, the settlements of natives composed of fugitive elements from as far east as Massachusetts and Connecticut succeeded in preserving their entity as members of a confederacy of prostrated small peoples. They became part of the loose political body known in later history as the Delaware Nation. That they still maintain this political status in the League of the Six Nations Iroquois in Ontario is fortunate for students of history, ethnology, and linguistics.

They have resided since about the middle of the eighteenth century in the basin of Lake Erie on its eastern extremity, and some 40 miles north of it, in a mixed prairie and deciduous forest horizon of the Alleghenian Life Zone. This habitat is important to hold in mind for reasons of avian distribution and environment. Assuming that ecological factors have to be considered, after migration of the people from a more southerly latitude, one can scarcely fail to wonder how much of their tradition is rooted in experience in Ontario. The migration to southern Canada would remove the people from the range of certain bird types of the middle states and bring them into that of some northern forms.

This paper covers one aspect of the knowledge still preserved in the band, treating the subject of its birdlore as known to a few of the elders in the group who are still conversant with the Delaware idiom.[4]

Concerning the idiom itself in which the bird names, calls, and some interpretations are given, it may be said that the grounds for assigning to it a single name coincident with any of the tribal names are not yet sufficiently adequate to permit more than a hyphenated classification, i.e., Munsee-Mahican. In a recent paper I have assembled the opinions of other investigators among the Six Nations Delaware (Brinton, Harrington, Michelson) who classified it as a Munsee dialect (Speck, 1945, pp. 7–18).[5] Upon closer examination of its morphology, vocabulary and phonetics, one gains the impression that Mahican contributions to the speech of the group in question are in evidence sufficiently strong to make the suggested hyphenated classification advisable for the present. The insistence of the people themselves in declaring that they are Wapanachki (Wabanaki), as are the Mahican, has been found to be valid beyond serious question. Through recent accumulation of material from its speakers a closer affinity has been discerned among Wabanaki dialects of northern New England than has hitherto been ascribed to them. This point, I believe, will appear more firmly supported in considering both speech and cultural composition of this group when the ornithological vocabulary to be presented is viewed against that of the Wabanaki proper, living to the eastward. With these suppositions I propose to leave open the question of constituency of the band until it can be better ascertained. Briefly, the Delaware group from which the bird notes have been recorded on the Six Nations Reserve is, according to historical testimony, an ethnic composite group; its dialect is a conglomerate of Wapanachki (Wabanaki) and Algonkian speech forms, and its birdlore is similarly constituted.

A word is called for as to the identification of birds and the use of English names for species by Indian people who know the

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[4] The field work of 1944–45 carried on among these people received substantial support from the Faculty Research Fund of the University of Pennsylvania, Grants 555 and 570.

[5] F. G. Speck, *The Celestial Bear comes down to earth; The Bear Sacrifice Ceremony of the Munsee-Mahican of Canada as related by Nekatcit*, Reading Public Museum, Reading, Pa., 1945.

local names only by association with English-speaking communities adjacent to the reservation. The Delaware informants were often confused over bird name-identities in English and the correspondence of those terms with their own taxonomy. The Delaware bird category indeed also shows, as might be expected, some confused identities under a single name.

The Delaware informants were, as we found, acquainted sufficiently with local bird types to identify and give their own names for about 70 species. Some years ago I incidentally undertook by similar means of the ethnological approach to record names and knowledge of birds in central Maine from an aged Penobscot hunter (Wabanaki of northern New England) and published the material where it has seldom been encountered by ornithologists or ethnologists.[6] The Penobscot bird list and nomenclature accounted for about the same number of species, seventy-two, as among the Delawares. Linguistic and historical implications with the Delaware data now presented are evidence. A rather strange coincidence develops, that informants in both groups could name about the same number of birds through their experience in the bush by what we may call casual knowledge and that a noteworthy proportion of them are similar despite the differences in environment of the two Algonkian divisions.

Realizing accordingly the inadvisability of relying upon bird listing with native names from the dictation of Indians by using only name identities in English, I resorted to the color figures and factual data given in Reed's handbooks.[7] This pocket edition was used to check the identities given and to supplement attempts to control the data. Having used these pocket bird manuals on frequent occasions in recording ethno-ornithological data among Indian tribes in northern and eastern North America, I have invariably found them satisfactory. Native informants likewise respond with warm interest to the stimulus of seeing illustrations emphasizing those characteristics which would enable identification to be made without relying upon mere names. In all, it should be noted that the matter as presented is not specifically ornithological but folkloristic.

The native informants whose knowledge is now recorded were Josiah Montour, born 1872, whose Delaware name is Xkó·kwsis, "Little Snake," a descendant of the historically celebrated Roland Montour, of early Mahican descent; Mrs. Jane Battice, his sister, born 1867; Jesse Moses, Sr., born 1869, likewise of Mahican extraction; his nephew Jesse Moses, Jr.; Nekátcit, born in 1859, known by the English name of Nicodemus Peters. Other sources when referred to are given in footnotes.

The system of representing sounds throughout the paper follows the use of English characters where possible, though with some different values in cases where the native terms are not reproducible in the English alphabet; for instance *c* represents English *sh*, *x* the *ch* in German as in "*bach*"; Greek alpha *α*, the *u* of English *but;* ɔ (reversed *c*) as *aw* in English *law*, the inverted ə an obscure vowel equivalent to *e* in English *flower*. Syllable accent is denoted by ′, nasalization of vowel by the cedilla beneath, and the aspiration, as the initial *h* of English, by ʻ. Crossed *l* (*ł*) is sounded like *thl* (Welsh *ll*) and *θ* like *th* in thin. By observing these variations in the sound values of English orthography, the reader should be able to reproduce the bird names with sufficient accuracy to be understood by the Delaware.

BIRD CALLS, SONGS, AND INTERPRETATIONS

Students of bird life, writing popularly or scientifically, have been inclined to attempt to transliterate what they think they hear birds utter or exclaim. The re-

[6] F. G. SPECK, *Bird-lore of the northern Indians*, Public Lectures by University of Pennsylvania Faculty, 1919–20, 7: 380, Philadelphia, 1921.

[7] C. A. REED, *Bird guide: Water birds, game birds, and birds of prey east of the Rockies*, 1910, and Part 2, *Land birds east of the Rockies*, 1912. The writer wishes to acknowledge the invaluable aid rendered in making the recordings by Ernest S. Dodge, curator of ethnology and natural history at the Peabody Museum, Salem, Mass., and his wife, Irene D. Dodge, who were members of the research party at work on the Six Nations Reserve, and participated in the bird sessions with the Delaware informants throughout the period of recording.

ception of such sounds by different ears seems to vary according to the national and linguistic tradition of the listeners. It is generally admitted, in fact candidly assumed, that few if any successful attempts have been made to describe bird songs and calls in English syllables. People in all ages and areas have tried to make nature talk in their own tongues. The humanizing of animal and even plant life has known no limit in folk tradition. Bird utterances have been a favorite playground for human fancy. The Delawares, as well we shall now see, have been as productive in word renderings of this character as the English. And like the latter their taxonomy has drawn its sources largely from avian call syllables. Just how these utterances could be endowed with sense aside from a rough resemblance to sounds, who can see? How the singing words of birds as heard by Delaware ears compared with English ears or with real vocables in any language, we can judge. It is worth noting at this point that the Indians nowhere associate bird calls with human names nor do they associate them with personalities. Who are the personalities that English tradition associates with bird memories; Bob White, Poor Will, Bob (Robert) Lincoln, Will's Widow, Mr. Peabody, for instance?

In the Delaware bird identities listed I have arranged the creatures in two groups determined by linguistic derivation of names. One is descriptive, the other onomatopoeic, the grouping in some cases optional, forty of the listed names being in the descriptive group, and twenty-three in the onomatopoeic list. It is a purely arbitrary one; a new manner of viewing source material obtained from preliterate natives. It does not follow any arrangement recognized by the Indians themselves or by students of bird life. The people, however, have devised a rough classification of birds by form and habit, since we find owls, hawks, ducks, woodpeckers, swallows, and some small birds to be designated by collective terms, and some subdivisions specified.

The generic term for bird is *awe'te'sːus*, and has reference to a creature having the power to go by flying. The final syllables *-te'sːus* appear in a large proportion of bird names, sometimes shortened to *-tes* or *-te'o*, "he who flies," in some names, as the listing shows. The plural suffix *-(w)ak* denotes the animate classification of birds with other living organisms.

Among the Delawares now living in Oklahoma who branched off from the Canadian divisions before the American Revolution, an entirely different term denotes the Aves, namely *tcólaːs*. Its etymology can not be clearly traced. Among the Six Nations Delawares (Munsee-Mahican speaking) another generic term is found, namely *jiːts*, for birds in general.

Turning eastward to the Wabanaki tribes of Maine, New Brunswick, and Province of Quebec, we find the corresponding class designation to be *siːps* (St. Francis Abenaki, Penobscot, Malecite), *sisip* (Micmac). Among the Mahican proper of the upper Hudson Valley as well as the Mohegan-Pequot of Connecticut, related inclusive terms are found, i.e., *jiːts* and *djiːts*. This substantive is evidently onomatopoeic.

The same second position elements *(-tésv(s), -esː)*, just given in the Canadian Delaware series, appear in Wabanaki bird name endings; *-tésːu*, and *-esː* (shortened form).

At this point it would seem apropos to mention that the Delaware, like other Algonkian peoples of the East, hold the impression that bats are classifiable with the birds. The tribe in question applies the name *pápiːsəlaŋgwunés*, "skin-wing bird," to any of the bats. The related Wabanaki of northern New England call the bat *madéganiːtésːu* ,"skin (hide) bird" (Penobscot and Malecite), *madaganiːtás* (St. Francis Abenaki). The mysterious bat has, indeed, been given an ambiguous zoological classification among many peoples of the world, as the word-traditions of both New and Old World languages show.

To the judgment of an ornithologist the list of species will seem incomplete for the region inhabited by the Munsee-Mahican Delawares. That a number of birds are conspicuously missing from the list is apparent. Many more might be thought to have received names with more or less accurately observed characteristics and identities. The

two or three members of the Indian band who knew the language, however, were aged persons possessing little more than a casual acquaintance with bird life. Despite the time and effort given to questioning and the display of bird pictures, their vocabulary of native bird names was limited to those given here—and some of them uncertain as to identity. Mistakes moreover inevitably lurk in the listings of native names with bird identities, for which informants and recorders are both responsible.[8]

BASICALLY DESCRIPTIVE BIRD NAMES

Mäxkələnéo, "snake bird," (?) red-tailed hawk (Buteo borealis (*Gmelin*)): This hawk is said to seize a snake and carry it high, soaring before an approaching storm. The Oklahoma Delaware name is the same as the above.

Weleɬcócɔcalnéʻniːɬat, "small bird killer," sparrow hawk (Falco sparverius *L.*).

Wápalanéo, "white bird," marsh hawk (Circus hudsonius (*L.*)).

θəniːléo, "stone bird,"—Wapándəp wéleːu, "whitehead bird,"—Mockándəp awéleo, "baldhead bird," bald eagle (Haliaeetus leucocephalus (*L.*)): The last name may have arisen through association with local whites. In the Delaware language of Oklahoma the name is *áixam.*

Míːmiːo (*meaning unexplainable*), *passenger pigeon* (Ectopistes migratorius (*L.*)): The meaning of this proper name is lost to the informants. It is therefore optional whether to list it with the descriptive names or to regard it as onomatopoeic. Josiah Montour recalls that in his youth these birds were common and that the people used a fifteen-foot pole to knock them down from the trees where they roosted. The Delawares of Oklahoma call the bird *amíːmi.* In the Wabanaki tongues its name is of a different derivation; *blɔs* (Penobscot), *pəláz* (St. Francis Abenaki), *ples* (Malecite), *polis* (Micmac)—terms whose etymology is not revealed.

Mowíːleo, "moaning bird," mourning dove (Zenaidura macroura carolinensis (*L.*)): The name is descriptive only in that it refers to the voice of the bird which announces impending misfortune or death to some member of the community. In Oklahoma the Delawares have expanded the idea of its voice into a phrase name, *mámendhákema,* "one who prays (or pleads) earnestly," and hold the dove in high sentimental esteem. Unlike the latter, the Canadian Munsee-Mahican have no sentiment against killing and eating the dove.

Tcáxkwiːs, "diver"—Aháp'tcalámwiːs, "holds breath when dives,"—Tcáŋkhiːs, "little (bird)," mud-hen, horned grebe (Colymbus auritus (*L.*)); *helldiver* (Podilymbus podiceps): These two birds of the waterways were so confused in identity that the informants could not agree on their correct names. On account of its body shape the "helldiver" is jokingly called *ópənak,* "potato." The bird figures in folklore of Algonkian peoples almost everywhere as a butt of humor. Penobscot and Malecite give *asóps* for its name.

Wápθowé ɬe, "white bird," wild goose (Branta *sp.*): The Wabanaki names refer likewise to whiteness; *wámptogwe* (Penobscot) *wáptuk* (Malecite), while it is *mogəlé wite* in Micmac.

Sək cíːhweo, "black duck" (Anas rubripes tristis *Brewster*): The generic term *cíːhwe* for duck goes back to a stem (*ciː*) for this bird group fairly uniform over a wide area in the East and North. Whether it is basically a mimetic sound or not is not easy to conclude. The generic term for duck in Eastern Wabanaki is *mədəhésːim.*

Xwás(θ) cíːhweo, "wood duck" (Aix sponsa (*L.*)): The name is another of the few Delaware terms listed that have been taken over from local white hunters. Other species of duck if referred to by the Delawares would be described by adjectives corresponding to their local English names.

Pəléo, "chewer (?)," wild turkey (Meleagris gallopavo silvestris *Vieillot*), (*also the domestic race*): Usage has adopted a different descriptive name for the bird among the Delawares of Oklahoma who call it *tcíː kənəm,* "he scratches (the ground)." A different series of name stems prevails in Algonkian languages to the eastward. They seem to be mimetic in origin, descriptive in usage—*néheme* (Penobscot), *nahamá* (St. Francis Abenaki), *neʻp* (Malecite), *neyhom* (Narragansett, Roger Williams).

Äʻkwáləne, "sleeps through the day," long-eared owl (Asio wilsonianus (*Lesson*)); *great*

[8] The nomenclature used in this report is taken from FORBUSH, E. H., and MAY, J. B., *Natural history of the birds of eastern and central North America,* Boston, 1939.

horned owl (Bubo virginianus (*Gmelin*)).

Lə́ni· k'hókos, "common, or original owl,"—Xóweygewi· k'hókos, "old fashioned owl," barred owl (Stryx varia *Barton*).

Wápi· k'hókos, "white owl," snowy owl (Nyctea nyctea (*L.*)): Essentially the same in the Wabanaki languages.

Káxwemwi·s, "killer," screech owl (Otus asio naevius (*Gmelin*)): Wabanaki cognates are *kamkámes·v* (Penobscot), *kapkámə·s* (Malecite).

Tcáyga k'hókos, "little owl," saw-whet owl (Cryptoglaux acadica (*Gmelin*)): Some difficulty was met with among informants in reaching conclusions over the identity of the owls in their own language. The questions were finally settled as given above, the identities of the two larger forms made by their vocal efforts. The term *k'hókos* is uniform for the series with minor variations over a wide area where Algonkian languages are spoken in the east, as the following examples will show: *kóhus* (Oklahoma, Delaware), *kokhokhas·v* (Penobscot), *kok'okhás* (Malecite), *kúkugwés* (Micmac).

Sək' awéles—Sək' awéleo, "black bird," crow (Corvus brachyrynchos *Brehm*): *Á́hasu* (see under Onomatopoeic names).

Putci·lí·letés·us, "butcher (derived from English) *bird," butcherbird* (Lanius *sp.*): The name deserves no further comment than to mention its English origin indicative of a kind of borrowing with loss of the native equivalent.

Tcatcanáxaxkwes, "striking at hazard on a tree," hairy woodpecker and downy woodpecker (Dryobates villosus (*L.*), D. pubescens (*Swainson*)).

Éyoθ awéleo, "dips while flying," flicker (Colaptes auratus luteus *Bangs*): There is no cognate to this name in Wabanaki idioms. The Penobscot term is *táwalotc.*

Lexáwaní·tcis; "fork-tail (swallow)," purple martin (Progne subis (*L.*)); *barn swallow* (Hirundo erythrogaster *Boddaert*): No differentiation of forms could be traced among informants.

Né'ni·mtcémwɔθ (né'ni·mtcéo), "lacrosse player," chimney swift (Chaetura pelagica (*L.*)): The bird's erratic motions in the air suggest the movements of Indian ball-players contesting to score a goal. Contrast this ancient idea in the name with the Penobscot *tcímili·tas·is,* "chimney bird."

Lí·li·tcas—Mi·lí·tcas, "smelling around (flowers)," hummingbird (Archilochus colubris (*L.*)): The variations in word form are given as pronounced by Josiah Montour and his sister, Mrs. Battice. In the Wabanaki speech we have *ani·tás·is,* "the hoverer" (Penobscot), *nanatás·is* (St. Francis Abenaki), *yalamés·it* (Malecite), with the same meaning.

Célamxákwus, "under the log," house wren (Troglodytes aedon *Vieillot*): The secretive flight habit of the bird is explained in folklore as being due to fear of the "lion" by day. A similar idea of the bird's habit is revealed in the Penobscot name *alɑmłabíkəs·i·s,* "under hiding bird."

Lawákaník·ɑn wéles·us, "middle of field bird," horned lark (Otocoris alpestris *subsp.*).

Ólələn·e, "blue tail (?)," wood thrush (Holocichla *sp.*): There was some doubt in the informant's mind whether this name was onomatopoeic or descriptive.

Á'ki·hes·, "planting bird"—Eha'ki·es·, "farmer bird," mockingbird (Mimus polyglottos (*L.*)): A rendering of the profusion of musical syllables uttered by the bird in question has become a tradition among the Delawares of this band. To their ears the following phrase is a repeated admonition to plant corn to ward off famine. It goes *toki· toki·k ehaki' ehaki ski· ski· kəmút* (with variations), *"toki·'toki·k* plant! plant! urinate! urinate! (to fertilize?) (lest) you steal!" Its arrival in their territory is accordingly a sign for the industrious to begin farming, and a warning to the slothful to avert the necessity of pilfering the crops of others in the season of harvest. The transliteration is furthermore a specimen of aboriginal humor.

Considerable discussion arose among three of the Delawares over the specific identity of this bird. The question centered about its appearance in the territory inhabited by them. An examination of ornithological literature on distribution of the bird allows for the possibility of its occasional appearance north of Lake Erie. Inasmuch as the mockingbird is a nonmigratory species and seldom gets to Canada, the present bit of folklore may possibly be a relic of the southern, pre-Canadian lore of the Delawares.

The Indians of the Reserve expressed no uncertainty of the identity of the mockingbird as distinct from the brown thrasher. Illustrations and a lengthy discussion of the differences in color of the two birds failed to convince them

of possible confusion of the two. They assigned a distinct name to the latter and were aware of the distinctions in feather markings characteristic of both forms. The conclusion was therefore reached that the mockingbird was known to them by observation and by name, and so the matter will be left for treatment by students of bird distribution in Canada to be checked by expert observation. In Oklahoma the Delawares, who are without question familiar with the mockingbird, designate it by reference to its polyglot gift, *nehəni·sk'tónhes*, "he talks about something."

Otán awéles·us, "town bird," English sparrow (Passer domesticus (*L.*)): This term indicates the late acquaintance of the people with the introduced species and correct observation of its preferred habitat.

Lən·owéles·us, "common (or native, original) bird," chipping sparrow (Spizella passerina (*Bechstein*)): The distinction between this species and the preceding lies in the recognition of their nativity.

Ci·ksánəle, "spread tail-feathers," kingbird (Tyrannus tyrannus (*L.*)): The bird's name is "belittler, scorner" in the Wabanaki area, *mesándjes·u* (Penobscot).

Wí·saweɬés·u, "yellow bird," Baltimore oriole (Icterus galbula (*L.*)); *yellow warbler* (Dendroica aestiva (*Gmelin*)): This name is applied possibly to the American goldfinch male in summer plumage, as far as could be learned from the informants.

Apatcémwes, "come back bird," meadowlark (Sturnella magna (*L.*)): The name has reference to its return north in the spring.

Pki·hixkaláygwes, "looking close for something," crossbill (Loxia *sp.*); *nuthatch* (Sitta *sp.*): The same name was given for both birds without possibility of clarification.

Ci·wópekli·s, "blue bird," bluebird (Sialia sialis (*L.*)).

Áxkokweldəpwi·l, "cook snake head," redwing blackbird (Agelaius phoeniceus (*L.*)).

Cikáks awɛ́ɬés·us, "skunk bird," bobolink (Dolichonyx oryzivorus (*L.*)).

Kówi awéles·us, "cow bird," cowbird (Molothrus ater (*Boddaert*)): Observation by the Delawares has resulted in the same name prevalent among the whites.

Cəwáni·les, "south, or salt-water, bird," snipe (Capella delicata (*Ord*)); *woodcock* (Philohela minor (*Gmelin*)): Either translation given is applicable to the species mentioned. The reference to salt-water indicates the former residence of the tribe on the middle Atlantic coast and may therefore be an ancient name carried to Canada in the migration of two centuries ago.

Xwátcə cəwani·les, "big south, or salt-water bird," killdeer (Oxyechus vociferus (*L.*)).

E'kí·ndjis, "little counting bird," brown creeper (Certhia familiaris americana *Bonaparte*): So named from its habit of moving up and down the bark of trees as if counting out or searching for something.

BASICALLY ONOMATOPOEIC BIRD NAMES

Mális—Méli·s, phoebe (Sayornis phoebe (*Latham*)): The 2-syllable equivalent of the call given by these birds seems to be the basis of their inclusion under one name of reference.

Tcɑyga méli·s, "little méli·s," wood pewee[9] (Myiochanes virens (*L.*)).

Tcúkwalè·, blackbird (sp.?) (bronzed grackle, and even red-wing blackbird according to one source): Again a resemblance to Mohawk (Iroquois) *djókwari·s* denoting the same bird. The corresponding Wabanaki name *tcəgwulúsk* also refers to the last two birds whose identity is combined in Penobscot and Malecite. The Oklahoma Delawares depart from the term in calling them *tckənákʷ*. That this is an ancient name for the blackbird among tribes of the Atlantic slope area is revealed by the entry in Edward Topsell's manuscript (circa 1614) giving "chugwareo" for the red-winged blackbird in the Virginia Indian language.[10]

Tí·ti·s, bluejay (Cyanocitta cristata (*L.*)): The term is fairly constant in the East; *dí·dias* (Penobscot), *títias, tides·ó* (St. Francis Abenaki), *títis* (Micmac).

Tci·ckó'kos, robin (Turdus migratorius *L.*): A certain uniformity is to be observed in

[9] On the islands off the coast of southern Massachusetts the name "moneybird" is given to the chickadee, phoebe, and wood pewee. The birds' calls are heard as equivalent of "taubut," meaning "thank you" in the Algonkian speech of the Southern New England Indians, the thanks being intended for the money that the birds refer to as about to be found. To these Indians the chickadee is understood to say the same thing and is likewise called the "moneybird" (information Mrs. C. Ryan, Gay Head Indian settlement, Marthas Vineyard, Mass., 1925).

[10] J. R. SWANTON, *Newly discovered Powhatan bird names*, Journ. Washington Acad. Sci. **24**: 97–98. 1914.

names for the bird in native languages of the East irrespective of their linguistic affinities. For instance the Cayuga and Mohawk (Iroquoian stock) of the Six Nations Reserve and adjoining the Delawares denote the robin by *tcí·ckogo*. The Delaware name is evidently related to the Mohawk, not to the Wabanaki term *wi·kwúskesu*. There was a Robin Dance in the ceremonial cycle of rituals of the tribe.[11]

Kaxkówes, brown thrasher (Toxostoma rufum (*L.*)); *cuckoo* (Coccyzus *sp.*): *Kax kax* is understood as the sound of their call notes, whence is derived the name of the birds that emit those syllables.

Máxkʷtci·li·lí·s, chickadee (Penthestes atricapillus (*L.*)): The onomatopoeic portion of this term (*-tci·li·lí·*) occurs in chickadee names among Indians over a wide area of the East, examples of which are given. The constancy of the name in various unrelated families of speech is evidently due to the clearness of utterance of the bird's canto in the acoustics of most people. That the common English name chickadee is Indian origin in America may not therefore be unreservedly true. The Penobscot equivalent is *ktci·gi·gi·łás·i·s*. Even the faraway and unrelated Cherokee of North Carolina give it the name *tcikili·líi*.

Pi·ckʷ, nighthawk (Chordeiles minor *Forster*)): The onomatopoeia in this case is an excellent echo of the bird's call note. Ornithologists have recorded a close equivalent, *peent* (F. M. Chapman, *Handbook of birds of eastern North America*, 1903, p. 238). A larger variety of the creature is said by the informants to exist in the country, called *xwátcəpi·ckʷ*, "big nighthawk." A popular belief also says "if a piece of deer meat is burned when it appears it will come down to earth, otherwise it never does." Josiah Montour mentioned another old folk belief that the bird fears the "lion" by night, as the wren does it by day, thus accounting for its erratic flight.

Related forms of the same name are found in other eastern dialects, *pick* (Oklahoma Delaware), *pesk* (Penobscot, Ojibwa), with only slightly variant forms in Iroquois Cayuga.

A formal term denoting the nighthawk is *pí·ckwəlanéo* when its name is referred to as the title of a mimetic dance in the series of rites anciently performed in the Delaware Long House. The Nighthawk Dance was a ritual in which certain dancers carried feather wands. It symbolized peace and war as antagonisms which are believed to be demonstrated in the character of the bird (Speck, 1945, p. 76) arising through the booming sound produced by the bird in flight. It is connected with the myth of thunder which symbolizes aerial and terrestrial warfare.

We'kóli·s (*wé'kwəlí·s*), *whippoorwill* (Antrostomus vociferus (*Wilson*)): The sound quality of this bird's voice is given in a 3-syllable imitation of its call noticeably constant in native languages of the East. The name series is most interesting.

In Oklahoma the Delawares hear the bird's call as *tcolulhówe*. In the central Algonkian and New England dialects the equivalents hold closer to the Canadian Delaware, viz., *wákowis* (Saulteaux), *wahonési* (Ojibwa, Lake Timagami, Ontario) (given as *wawonaissa* by Longfellow in Hiawatha), *kukuwé* (Fox of Oklahoma), *mɑkowi·s*, "little child or dwarf" (Mohegan), *wi·polés·* (Penobscot), *papolés* (St. Francis Abenaki), *wekwi·i·tc* (Micmac). The linguistically unrelated Cayuga (Iroquois of Six Nations, adjacent to the Delawares) call it *gwękuyé'*, while the Catawba (South Carolina) linguistically distinct from all of the preceding give a similar sound-form *witkoyą*, and the Cherokee (North Carolina) *wagulí·'*. Finally we note the interesting form of the echoic name among the Dutch settlers of the lower Hudson Valley as *quote-ker-kee*, recorded by Neltje Blanchan (*Bird neighbors*, 1922). The Canadian French hear the call as *pois pourri*, or "rotten pea." To none of the northern people is the bird's presence a happy omen. The poetical fancy entertained by the southern Indians that the whippoorwill does not appear until the ladyslipper (*Cypripedium acaule*) blooms so that the bird can use it for a hat is not revealed by inquiry among northern tribes so far (F. G. Speck, *Whippoorwills, nighthawks and ladyslippers*, Gen. Mag. and Hist. Chron., Univ. Pennsylvania **36**: 595. 1934).

Máxkawełes·—Máxkawełáci·c, "red bird"; Sótcəl awełásos, "soldier bird," scarlet tanager (Piranga erythromelas (*Vieillot*)): The first name listed was given by Nicodemus Peters

[11] F. G. Speck, *The Celestial Bear comes down to earth; The Bear Sacrifice Ceremony of the Munsee-Mahican in Canada as related by Nekatcit*, Reading Public Mus. Sci. Publ. No 7: 74. 1945.

(deceased 1938), the second by Josiah Montour. The latter has reference to the red-coated British soldier so familiar to Indians a century ago.

Kaskáskwəli·s, song sparrow (Melospiza melodia (*Wilson*)): The sound phrase is considered to be a close reproduction of the first part of the spring melody of the bird, and from this its name is derived. The full equivalent of its utterance is "kaskáskwəli·s asi·'takəlá's, məsá'si·tepók." The last word of the phrase is interpreted to say "cold feet." The reference to cold feet indicates the suffering that the bird expects to undergo before steady warm weather starts in during the uncertainty of a belated spring.[12]

The Delawares are conscious of the similarity of their own name for the bird to that given it by the neighboring Mohawk, who interpret its song as saying "kaskáskəli· sa'si·takalá's," "your foot smells foul."

Equally expressive is the Penobscot euonym *sulsulsuwí·* for the song sparrow. The tunefulness of names given the bird in many eastern dialects is noteworthy among people of the northern latitudes who perceive the return of spring in the singing syllables of such a melody as is given forth. In Malecite the term is practically the same (*sulsulsulí·*) while St. Francis Abenaki has *kaskaldjás*, a closer analogy to the Delaware name.

Tcuwí·yu', *towhee*, Pipilo erythrophthalmus (*L.*)); *catbird*, Dumetella carolinensis (*L.*)); *bobolink*, Dolichonyx oryzivorus (*L.*): It may be imagined that the local name chewink used generally among whites in parts of the East has been imitative of the Delaware name, yet the distinct character of the bird's call could be considered as the source of the name in any group of residents, white or Indian. The occurrence of the single Delaware term applied to three distinct bird forms is a corroboration of the idea previously expressed in respect to the basis of classification of birds by their utterances rather than by morphological characteristics. This is another truly old bird name among the Indians of the Virginia Algonkian area, for the Topsell manuscript (1614) gives "chuwheeo" for the towhee. (See reference to Swanton, 1914.)

Mémeo, pileated woodpecker (Ceophloeus pileatus abieticola *Bangs*): This great bird is a figure in eastern Indian myth and legend. The Delawares interpret its call into English, hearing it as *wet! wet! wet!*, a sign that it will soon rain. The bird's beak was used to clean out the ears of a person afflicted with deafness.

The name *méme* is unquestionably an old one, general among Algonkian-speaking tribes of the North Atlantic region, and an ancient representation of the bird's call unchanged through time. In the Wabanaki tongues we have *méme* (Penobscot), *máma* (St. Francis Abenaki), *méme* (Ojibwa).

Mämaxókwəs, "mémeo red head," red-headed woodpecker (Melanerpes erythrocephalus (*L.*)): The apparent relationship of this to the preceding bird is responsible for its secondary name. Exact identity was uncertain.

Mé'k'hɑm, "pump," bittern (Botaurus lentiginosus (*Montagu*)): Here is a correspondent to the utterance of the bird as it has appealed to European ears, described graphically by authors as related names appear in the Wabanaki area; *pokhámənəs* (Penobscot and St. Francis Abenaki).

Káxko, great blue heron (Ardea herodias *L.*): This echoic term is another constant in bird nomenclature of the eastern tribes, viz. *kásko* (*kask^{w}*) (Penobscot).

Áhasu, crow (see under descriptive names): This mimetic term corresponds to Wabanaki forms, *kagó's* (Penobscot).

Á·kawán·eo—Mətéwi·le, American and red-throated loon (Gavia *sp.*): The first term is a form of the sound of laughter uttered by the bird, as the informant added "ha ha kowane, ha ha, he says." The second was not clearly translatable. It is a cognate with the name applied to the bird by the Wabanaki people of northern New England, *mədéwi·lə*, Penobscot, *madawi·lá*, St. Francis Abenaki (see Gull below).

Ka·k^{w}, wild goose (Branta *sp.*), *swan* (Cygnus columbianus (*Ord*)): Informants were un-

[12] An appreciation of the same quality of its song as that sensed by the Indians is shown in the following words of F. Schuyler Mathews: "It is not possible to listen to the melody of the Song sparrow in early March without realizing for the time being that we are released from the cold clutch of winter and set down in the comfortable lap of spring" (*Field book of wild birds and their music*, 1904, p. vi). In the body of his book (pp. 111–123) he devotes about ten pages to attempts at musical transcriptions and word equivalents of this bird's song.

able to differentiate the names of the two birds. The swan to them is nothing more than a vague memory. The name is derived from the flight call of the goose, it would seem.

Ákawanéo, gull (species not differentiated) (Larus *sp.*): The Delaware notion that the bird announces itself by the cry *ákawa-* is related to the Wabanaki idea in the vocables *ki·ɑksi·s* (Penobscot), *kiákʷsi·s* (Malecite), *kákwi·s* (St. Francis Abenaki) as names for the herring gull.

Po'pó'kus, quail (Colinus virginianus (*L.*)): The name is derived from its call, which to European ears suggests *bobwhite.* The same name appears in several forms in eastern Algonkian tongues as *popókus* (Oklahoma Delaware).

Pa'pá'ko, ruffed grouse, partridge (Bonasa umbellus (*L.*)): The drumming of the male bird is denoted by the verb stem of its proper name.

Ki·kí·pus, chicken (*domestic*).

Migrational lore of the Canadian Delawares has been collected recently by Jesse Moses, a member of the group, and placed at my disposal for use in this report:

All feathered wildlife that cannot endure the severity of the northern winter migrates southward in the fall in the order of the first to leave in the fall being the last to return in the spring.

The small birds and ducks are believed to have chosen their mates before returning north, while the geese return in flocks leaving the ganders to battle it out for their mates on the breeding grounds.

Occasionally some of the hardier birds, such as the song sparrow and jay, do not go south for the winter, which indicates an open mild winter.

An early migration either way portends an early change of season. The non-return of normal bird life means a lean year, while an unusual number augurs plenty. The presence in this area of the snow-field birds, white owl, northern lark, waxwing, and snow bird, means an unusual depth of snow and severe cold in their regular habitat.

It is known that birds, ducks and geese, return to the locality where they were hatched, with the parent pair having priority in their particular nesting place.

The V formation of flocks of ducks and geese in flight is believed to be held for reasons of protection. In flight the neck can only be carried in a straight line and the head has very little range of turning. So the position and behaviour of the leader is transmitted visibly from him or her, as the case may be, down the line by that eye of the follower on the inside of the V formation, while each one in the flight has open vision on the outward side. Signals of the intention of the leader are sounded and relayed by others in the flock.

The sense of direction in flight by day or night is held by the calling of a manitu, according to which one is to govern the coming season, be it winter or summer over which the manitu of the north or the heat of the south is to rule. There is another belief that the rolling of the thunder northward or southward in the late winter months indicates whether spring is to take over soon or is to be pushed southward again for a time. These signs indicate the struggle taking place among the manitu forces over the question of control of season.

High-flying flocks are believed to foretell lean physical conditions for the approaching season, low flying flocks the reverse.

The foregoing observations are recalled from narrations by my uncle Cornelius Moses and some other old Delawares.

We have not as yet recorded the belief among these Delawares that small birds migrate on the backs of geese, loons, cranes, or other large birds. That this legend has not been recorded seems strange in view of its occurrence among Wabanaki tribes farther east who are linguistically akin to the Delawares.[13]

[13] The extent and variation of this belief among northern Algonkian-speaking tribes were made the subject of some review and discussion in an article by the writer published in 1921 (Speck, *op. cit.*, pp. 374–379).

ANTHROPOLOGY.—*More filed Indian teeth from the United States.*[1]

T. D. Stewart, U. S. National Museum, and P. F. Titterington, St. Louis, Mo.

In 1944 we described in this Journal four examples of filed Indian teeth coming from a small area within a radius of 40 miles of St. Louis, Mo. At the same time we mentioned two other examples that had been reported but that we had not seen. One of these, originally from Arizona, had been sent to Australia but has now been described by Campbell (1944).[2] The other, from Macon, Ga., was referred to briefly in our footnote 4, as follows: Dr. Gordon Willey tells us that a skull with a transverse groove on the labial surface of each median incisor was found in a Lamar culture site near Macon, Ga. Efforts to secure this skull for examination have been unsuccessful thus far." Not until February of this year was this specimen finally located and sent to one of us (T.D.S.) for study.[3]

Since our report brought together unexpected evidence of a widespread, unfamiliar custom among the late prehistoric Indians of the United States, we anticipated that anthropologists with skeletal collections of these Indians would soon find more examples and would make them known. So far, rather surprisingly, only one new specimen has appeared, and it was discovered in an Illinois collection by one of us (P.F.T.). This being the case, and a sufficient time having elapsed for searches of collections to be completed, it seems desirable to record without further delay these two undescribed specimens. There is the further motivation that both of these two new specimens exhibit transverse grooves of the upper median incisors, which, heretofore having been seen only in an isolated tooth, gives increased significance to this unique type of dental mutilation.

DESCRIPTION

Macon, Ga., skull (46-3/13B:25).—The burial of which this skull is a part was found with associated small disk shell beads in a small mound, known as the Tufts Mound, near the Ocmulgee River bluffs in South Macon. Dr. Kelly[4] characterizes this mound "as presenting an interesting deposition of a Swift Creek and early stamped pottery complex over an original 'potteryless' or 'pre-pottery' site." He regards the burial in question as intrusive, because the associated beads, in his experience, can be typical of either Macon Plateau or Lamar burials. This means that the Macon Plateau and Lamar cultural complexes, being of the Middle Mississippi phase, are late prehistoric, whereas the Swift Creek complex is much earlier (cf. Waring and Holder, 1945, pp. 22–25).

Inspection of the skull reveals a round- and high-headed individual (undeformed (?); C.I. 84.0; Mean Ht. I. 96.0), probably a female, in early middle age. The sex is suggested by such things as the small size (cranial module 148.0), absence of supraorbital ridges and muscular markings, rounded chin, etc. Age is indicated by the good condition and moderate wear of the teeth together with beginning ectocranial suture closure (endocranial closure is advanced).

The most striking features of this skull however are two symmetrically placed depressed scars on the frontal bone[5] and a set of aligned grooves crossing the upper median incisors (Fig. 1). There is no reason to believe that these features or defects have any etiological connection. The frontal scars probably are either traumatic in origin or due to syphilitic gummata. Lesions seemingly due to syphilis are quite common in collections of bones from sites of the Middle Mississippi cultures. On the other hand the dental mutilation, if such

[1] Received June 17, 1946.

[2] Recognizing the importance of this specimen to American anthropology, the South Australian Museum courteously has returned it to the U. S. National Museum.

[3] We are indebted to Dr. A. R. Kelly for his efforts in locating this specimen and for making it available for study.

[4] Personal communication, dated February 5, 1946. See also Kelly, 1938, footnote 6, p. 26.

[5] Two other scars can be felt better than seen.

it is, can be only a deliberately planned artifact.

As seen under magnification (Fig. 2) the grooves in the upper median incisors present some unusual details. In each tooth the superior edge of the groove is rounded, somewhat lobulated, and undercut, whereas the inferior edge is gradually sloping or beveled and smooth. The groove in the right incisor crosses the entire width of the labial crown surface, but the groove in the left incisor fails to reach the edges of the labial surface and especially on the medial side. Here the groove is almost completely blocked by intact enamel. The latter is rounded and somewhat undercut. This fact makes it difficult to understand how a crude file could cut as deep as the defect indicates without cutting all the way across the tooth surface. Indeed, when observed from the side, the continuity of the two grooves is spoiled by this block, which suggests that a continuous motion of a blade file could not have been employed to produce the two defects.

In the depths of each groove a secondary carious process has developed. Also, in each case the enamel surface between the groove and the neck of the tooth is slightly pitted as in true hypoplasia. The grooves themselves do not correspond to the usual hypoplastic defects, both because of the atypical beveled inferior edges and because of the fact that there are no corresponding defects on the other anterior teeth.[6]

Hypoplastic enamel usually appears in all tooth-crowns undergoing development at the time the disturbance in enamel formation took place. In the present case the defects in the upper median incisors correspond to the increment level reached at about the third postnatal year. At this age the crowns of the lateral incisors, canines, and premolars, both upper and lower, also are developing, yet in the present case none of these show such defects.[7]

Contrarily, of course, the distributional limitation of the grooves and their beveled edges partly correspond to the conditions in the next case to be described, the artificial nature of which is unquestioned.

Dickson skull (D-22).—In August of 1944 one of us (P.F.T.) spent a day at the Dickson Mound Museum at Lewistown, Ill. In the course of examining some of the skulls of the Dickson collection for filed teeth the specimen to be described was discovered. Dr. Don F. Dickson states[8] that this skull was recovered from a burial exposed over 40 years ago in grading the upper part of the mound for buildings. The skull, without its lower jaw, was the only part saved.

Although there were no cultural associations with this burial, the Dickson cemetery, according to Cole and Deuel (1937, p. 121), is classified as Middle Mississippi. Indeed, they say that "the virtual absence of materials which might be classed as Woodland serves to mark [the Dickson cemetery] as a 'pure' Mississippi site." In addition, Neumann (1937) reports that most of the skulls from this site are deformed.

On examination the skull shows moderate fronto-vertico-occipital deformity and appears to be a young adult female. All the cranial sutures are open, with the probable exception of the basilar, which is almost completely destroyed. The teeth show only slight wear.

As seen in Fig. 1, the upper median incisors are crossed by a set of aligned grooves somewhat closer to the incisal edge than in the previous case. When these grooves are observed from the side, their alignment and continuity become more apparent. This suggests that they were made at the same time and that the filing instrument made a continuous sweep across both teeth. This filing process perhaps was facilitated by the

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[6] The lingual surface of each upper median incisor is shovel-shaped as in most Indians. The proximal end of the shovel basin, unusually squared and slightly pitted, is at exactly the same level as the defect on the labial surface and, of course, corresponds in direction.

[7] Dr. T. J. Hill, of Cleveland, Ohio, and Dr. Daniel J. Lynch, of Washington, D. C., both feel that the grooves are artificial and both advanced these arguments in ruling out hypoplasia. We are indebted to these men for giving us the benefit of their opinions.

[8] Personal communication dated September 14, 1944. We appreciate Dr. Dickson's kindness in sending the specimen to the U. S. National Museum for study.

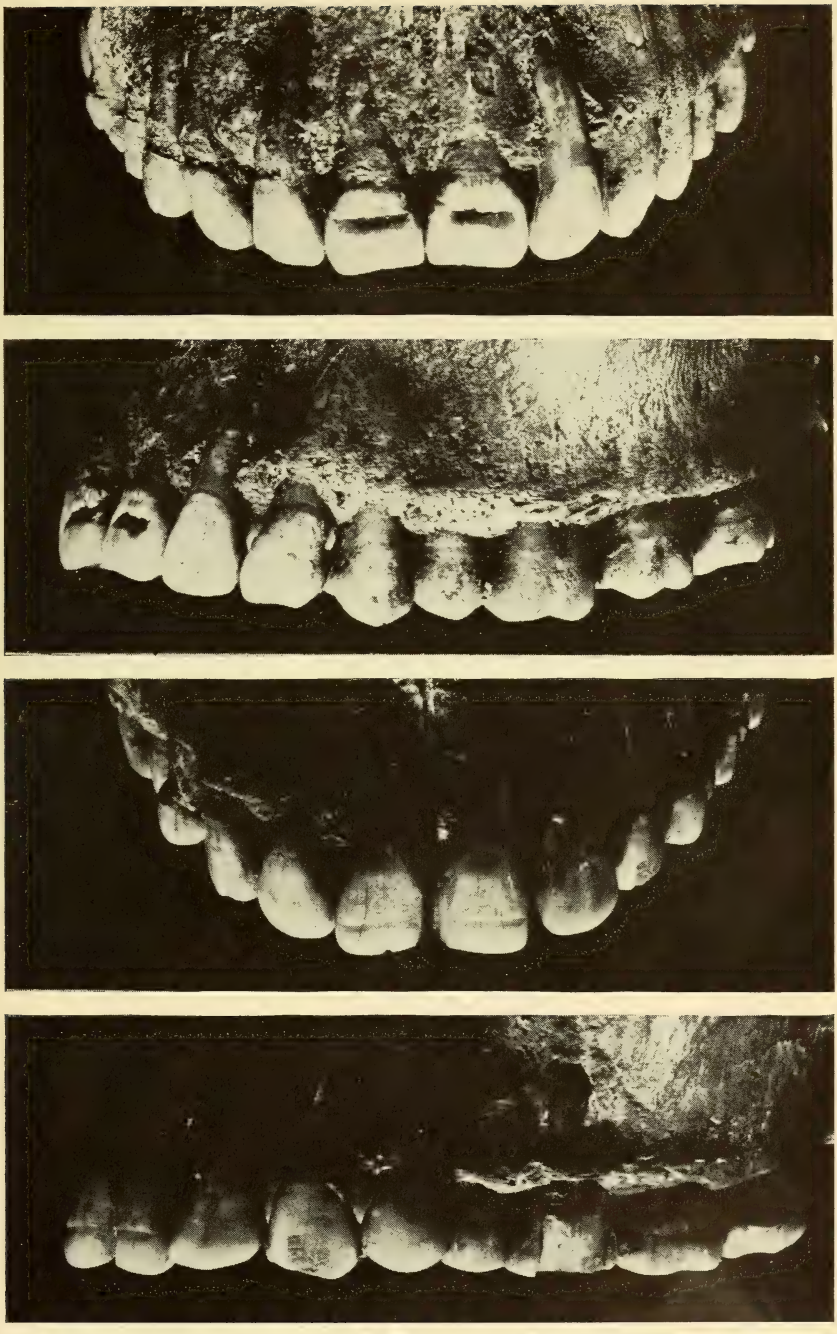


FIG. 1.—Upper two views show the defects in the median incisors of a skull from Macon, Ga. (46-3/13B: 25). Lower two views show the defects in the median incisors of the Dickson skull (D-22).



FIG. 2.—The defects in the median incisors of the skull from Macon, Ga., seen in enlargement (×3).

fact that both of the median incisors had undergone a slight inward rotation. As seen under magnification, the edges of these grooves are rounded as from polishing and the striations left by the file are largely obliterated.

A small /\-shaped notch in the incisal edge of the right median incisor will be noted. This is perhaps an incomplete expression of the multilation pattern exhibited by the isolated Cahokia tooth described in our previous paper.

DISCUSSION

The above description leaves some doubt as to the artificial nature of the dental defects in the skull from Macon, Ga. This doubt arises from the fact that these defects have some of the characteristics of hypoplasia; that is, at some points about the edges of the defects the enamel is rounded, lobulated, and undercut. Even the alignment of the defects is characteristic of hypoplasia. However, as pointed out above, the absence of like defects at corresponding increment levels on the other anterior teeth rules out generalized hypoplasia.

But we still have to consider the possibility of local disturbances of enamel formation. According to Bunting and Hill (1940, p. 94) this may occur as a result of abscesses on overlying deciduous teeth. Although such a possibility can not be excluded in the present case, it would seem highly unlikely both because of the low incidence of caries in deciduous incisors among Indians and because of the high resistance to decay exhibited by the permanent teeth.

The alternative is to regard these defects as artificial but altered by secondary caries and by abrasion resulting from many years of chewing coarse foods. The age of this individual favors this view, as does the cultural setting in which the burial occurred. Nevertheless, without the supporting unquestionable evidence of the Dickson specimen, derived from the same cultural phase, we should hesitate to characterize the dental defects in the Macon specimen as artificial.

With this reservation we may pass to the significance of these new finds. First of all, it is clear that the type of dental mutilation consisting of filed transverse grooves was not an isolated experiment of the American Indians. There are now examples from two different sites in Illinois, and perhaps one from Georgia. Secondly, so far as we know, this type of mutilation was unique to the Indians of the eastern United States. Thirdly, the belief is supported that within the United States all types of dental mutilation were confined to the peoples of the Middle Mississippi culture phase in the East and to contemporaneous peoples elsewhere. In other words, all seven specimens thus far described relate to the late prehistoric period. And fourthly, dental mutilations were not limited to one sex.

Finally, we should like to repeat our belief that tooth grooving, through its association with tooth notching, indicates contact with Middle America, where the latter practice was common. Furthermore, since tooth grooving seems to be unique to the area of the United States, this may mean that "distance and a new setting had released the original custom from its habitual limitations."

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ARCHEOLOGY.—*A prehistoric Indian site on Selden Island, Montgomery County, Md.*[1] RICHARD G. SLATTERY, Washington, D. C. (Communicated by W. R. WEDEL.)

On October 21, 1945, Hugh V. Stabler and the writer explored Selden Island in the Potomac River, Montgomery County, Md., for signs of early Indian settlements. A chance test pit dug into a low ridge on the island disclosed disturbed soil mixed with charcoal, burnt earth, and aboriginal artifacts. This discovery led to subsequent excavations and the partial delineation of a hitherto undescribed archeological complex.

Selden Island, located about 30 miles northwest of Washington, D. C., is named after an early owner. At the present time it is part of a 700-acre tract of land owned and operated by W. A. Walker, of Ashburn, Va. The Potomac River at this point has carved a passageway through a stratification of Triassic sandstone, creating a valley $1\frac{1}{2}$ miles wide, with 100-foot bluffs on each side. The island, which is about $2\frac{1}{2}$ miles long by half a mile wide, lies near the Virginia shore. The highest point on the island rises about 30 feet above the river level at normal flow and 200 feet above tidewater.

The site under discussion occupies a terrace in the east third of the island about 200 yards southwest of the main stream and is half a mile east of a brick house constructed nearly a hundred years ago. At least two other aboriginal village sites are known to exist on the island.

At the site in question there was no concentration of surface debris to indicate that prehistoric man had ever occupied the spot. Recurrent floods have deposited their load of silt on this part of the island, covering any signs that may have been left by ancient man. However, an occasional sherd, arrowpoint, or other worked stone may be picked up on the surface at this point as on almost any other cultivated spot on the island. It is perhaps reasonable to assume, therefore, that these artifacts were brought to the surface by the plow or, in some cases, were scattered by later Indians.

Since its discovery the site has been excavated by means of numerous test trenches dug at intervals in a 30- by 35-foot area adjacent to the first pit. Owing to the excessive overburden of sterile soil (14 to 18 inches) and our limited facilities, it was impractical to strip off the entire surface to subsoil level. For these reasons the exact extent of the area occupied has not been determined. The aboriginal features discovered consist of a series of 12 separate rubbish-filled pits each conforming to a nearly circular shape (see table). The walls were generally vertical with little variation from top to bottom; however, three pits, Nos. 3, 9, and 12, apparently had sloping basinlike walls. The diameters, measured at the contact between dark topsoil and light-colored subsoil, ranged from 34 to 57 inches, but generally held to near 3 feet. The depth varied from 24 to 41 inches (taken from surface) but averaged about 30 inches. Pit No. 4 was floored with 60 broken and unbroken rocks completely covering the bottom of the pit. Intermingled with these rocks were many fragments of a single large pottery vessel. Pits Nos. 6 and 8 had been dug through a stratum of river-deposited gravel and rock, much of which had become mixed with the pit fill. This stratum began at a 24-inch level and continued through the walls and beyond the bottom of the excavation. Absence of this gravel in the other pits opened indicates that it is of limited or discontinuous occurrence and does not underlie the entire site.

The pits excavated generally revealed one point of difference from those on other aboriginal sites in this area in that there was

[1] Received April 11, 1946. The exploration of the Selden Island site was carried out wholly on week-end excursions by Mr. Stabler and the writer. We were accompanied on several occasions by Frank M. Setzler, Dr. T. D. Stewart, and Dr. Waldo R. Wedel, of the Department of Anthropology of the U. S. National Museum, who offered their assistance and trained experience in the excavation of the site and the preparation of this paper. The writer wishes to convey his gratitude also to Mr. Walker, who extended his fullest cooperation throughout the period of our explorations, and to Mr. Stabler for assistance and suggestions during excavation of the site and in subsequent analysis of data. The specimens from the site have been deposited in the U. S. National Museum.

very little difference in the consistency of the fill and that of the surrounding walls except for coloration and even this was not always sharply defined. The fill in each contained darkened soil, charcoal, and some flecks of burnt earth but was without exception very hard-packed.

There was no evidence in any of the pits of fire-baked walls, layers of ash, or concentrations of charcoal that might indicate use in cooking, pottery firing, etc. The layer of rocks found in the bottom of pit No. 4 might indicate its use as a storage pit, the rocks placed so as to protect the contents of the pit from excessive moisture which would tend to be greatest on the bottom. Whatever their original purpose, the pits were finally used as refuse depositories into which broken articles and rubbish from the nearby habitations were thrown indiscriminately at all levels.

There was no positive evidence of large concentrations of sherds and artifacts outside the immediate pit areas as one would expect to find in so-called "kitchen middens." However, occasional sherds and points were found near the bottom of the topsoil throughout the entire area excavated.

The table below summarizes pit measurements and contents.

POTTERY

Potsherds were much less abundant in the refuse pits of the Selden Island site than on any other village yet explored in the area; however, 431 sherds and 1 partially restorable vessel were recovered from the 12 pits and test trenches. Of this total 93+ per cent were tempered with coarsely ground steatite. The remaining sherds were tempered with very finely divided crystalline rock.

The closest known quarry of steatite is located just below Little Falls in Arlington County, Va., a distance of about 25 miles (Holmes, 1897, p. 124). The steatite particles comprising the tempering varied from 1 to 4 mm in diameter and were always used generously. Holmes (1903, p. 48) comments as follows on the use of steatite tempering: "In the piedmont region of North Carolina and Virginia vessels are found made of paste consisting of coarsely pulverized steatite and barely enough clay to hold the particles together." A coarse paste of this nature greatly affects the surface smoothness in weathered pieces. Those sherds not appreciably weathered have relatively smooth surfaces, but are occasionally pitted where particles of the tempering material have fallen out.

Sherds of both temper types characteristically have strongly weathered surfaces as if produced by poor methods of firing or by extended exposure to the action of soil acids and water. The sherds are generally soft in texture and will crumble readily if immersed in water before being thoroughly dried. Surface treatment of the body sherds was generally fine cord-roughening produced by a cord-wrapped paddle; the impressions may

Pit No.	Depth	Diameter	Sherds	Arrow-points	Worked steatite	Worked stone	Ax fragments	Organic material
	inches	*inches*						
1	31	39	25	0	0	25	1	1
2	26	44×50	34	1	1	12	0	1
3	26	36	74	2	0	16	0	0
4	31	36	100	3	0	7	0	0
5	24	34	12	2	0	4	0	0
6	27	36	43	5	0	4	0	0
7	28	38	20	0	0	2	0	0
8	41	57	46	3	1	8	0	0
9	25	39	34	6	1	8	0	1
10	39	42	3	3	1	14	0	0
11	26	36	14	0	0	7	1	0
12	24	48	2	3	0	14	0	0
Test trenches	—	—	24	2	0	9	0	0
Totals			431	30	4	130	2	3

be vertical, oblique, or crisscross (Fig. 1, *a–c, e, h*). In some steatite-tempered sherds net impressions occur; others have what appears to be the imprint of twined matting with heavy warps crossed by a fine tightly twisted cord weft at intervals of three-eighths to one-half inch. These latter impressions are strikingly similar to those described by Holmes (1903, p. 28, pl. 3) as occurring on "salt-pan ware" of the lower Mississippi Valley. All samples of grit-tempered sherds recovered from the pits were plain cord-roughened with no further elaborations.

Twenty-two steatite-tempered rims were found; there are none with crystalline tempering. The rim sherds in all cases are merely extensions of the body of the vessel and were either smoothed off on the lip, corded, or notched (Fig. 1, *a, b*).

Vessel shapes are very imperfectly known but our sample suggests that they varied in diameter from 11 to about 30 cm, as measured from projected arcs on restored fragments. The steatite-tempered vessels in some or most cases appear to have been flat-bottomed or nearly so (Fig. 1, *a*) and often bear heavy net or fabric impressions on their under surface. The angle formed by the body of the vessel and the bottom was in some cases about 90° but in others seems to have been less abrupt. In every case the vessel reached its maximum thickness at this point. Thickness of body sherds varied from 4 mm to 15 mm; the majority were between 5 and 9 mm.

Coloring was generally light brown throughout with varying darker shades produced by uneven firing.

Some steatite-tempered vessels had lug handles protruding for about 15–30 mm at right angles from the side of the bowl (Fig. 1, *i, j*). Presumably these vessels had two such grips below the rim. These lugs appear to be modeled closely from those found on large steatite bowls of this area for they were generally flat in appearance and tapered to blunt points. It is believed that the width and overall size of these lugs varied proportionately with the size of the vessel.

Two cases of holes in sherds, one being drilled after firing and the other thrust through the wall before firing, were found among our collection. An illustration of the latter type is shown in Fig. 1, *a*.

STONE ARTIFACTS

Stonework at the Selden Island site was not abundant. Thirty complete and broken projectile points (16 of which were classifiable as to shape) were recovered along with two grooved ax fragments, several pieces of worked steatite, and two rounded marble-size stones.

By comparison with collections of projectile points from other piedmont Potomac village sites, those from the Selden Island site appear unique only in the absence of triangular shapes. This type is found in all cases in greater abundance than stemmed points on all other sites yet explored in this area (Stearns, 1940, p.13; Manson, McCord, and Griffin, 1944, p. 399). Three of the 16 classified projectile points possessed rounded bases; all others were stemmed. The length of all types varied from 1 to 4 inches. The largest specimen was imperfect, and its size is a conservative estimate.

The stones most generally used for the manufacture of projectile points were native to the vicinity and include quartz, quartzite, and rhyolite (Holmes, 1897, p. 73, describes rhyolite quarries at Maria Furnace, Pa.). In general, the quality of chipping was good. The points compare favorably with those of similar material from other sites. A few flakes of chert were found, but this stone was not represented in any of the points; its lesser use may have been due to the scarcity of the material.

As previously mentioned, two fragments of grooved stone axes were found on the site: a fragment of one side broken at the top of the groove and at $1\frac{1}{8}$ inches below the groove, from pit No. 1, and the other, a section of one side from half an inch above the groove to the bit, from pit No. 11. Presumably the groove completely encircled the implement in both cases, as indicated by surface finds from other sites of this culture. The fragment from pit No. 1 was fashioned from an igenous rock (greenstone) and was much weathered. The other specimen was shaped from Triassic sandstone and was

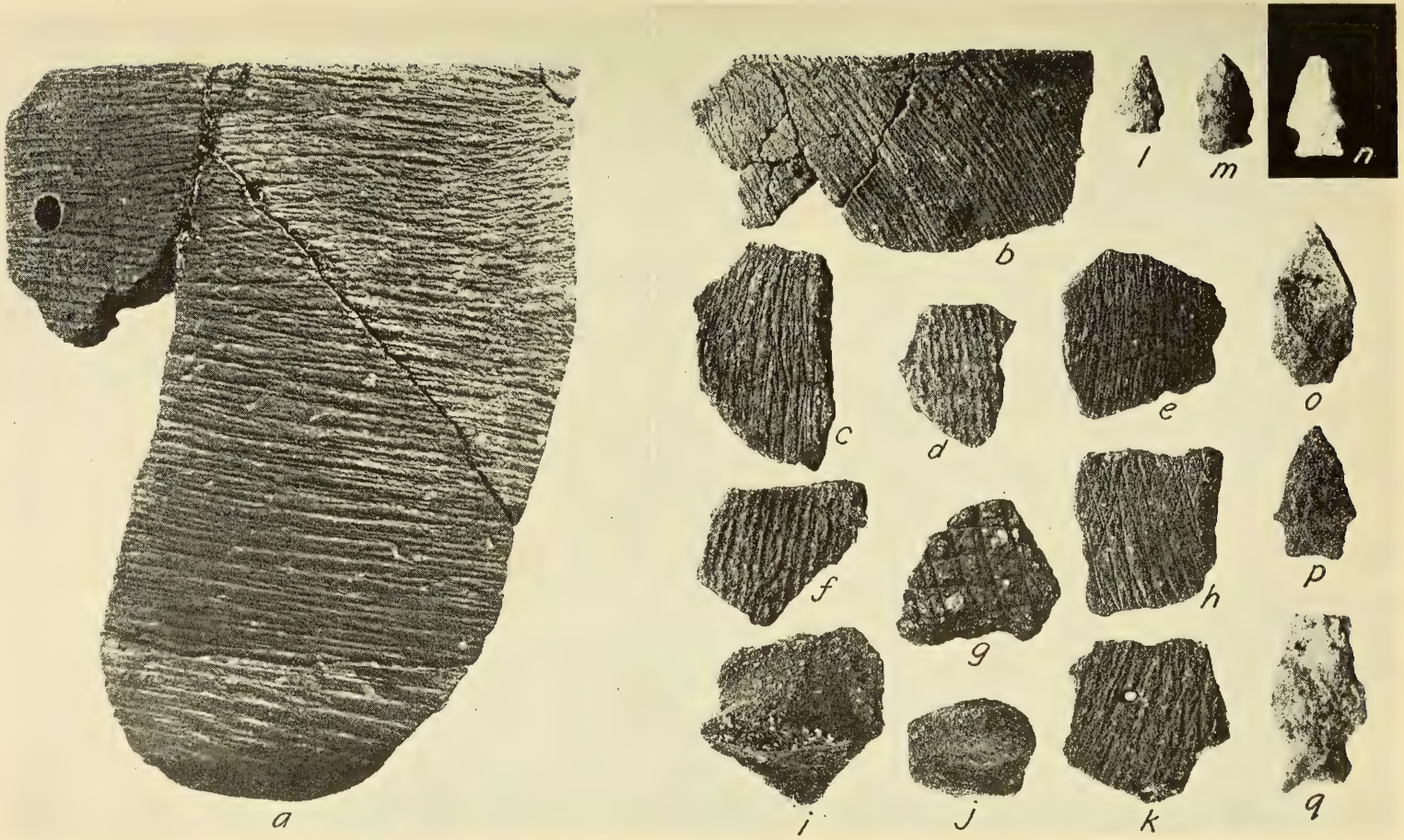


FIG. 1.—Potsherds and chipped projectile points from Selden Island, Montgomery County, Md.
Height of *a*, 120 mm; width of *b*, 125 mm.

similarly weathered. Stearns (1940) in his report on the Hughes site and Manson, McCord, and Griffin (1944) in their report on the Keyser site do not mention grooved axes but note that celts are characteristic of both sites. The writer's personal experience in excavating Indian villages of the piedmont Potomac area agrees with their findings in regard to the occurrence of celts and the nonoccurrence of grooved axes on all sites explored other than the type here discussed. There is no trace of celts in our collections from this excavation.

One steatite bowl fragment, half an inch thick, was found in pit No. 10. This was a section from the junction of the side and bottom. It is impossible to determine the size and exact shape of the bowl from this sample, but the bottom of the vessel appears to have been flat; the sides approach it at about 115°, giving the effect of a rather sharp angle on the outside surface and a curving radius of about 2½ inches on the inside surface. This was obtained by thickening the vessel at the radius to three-quarters of an inch. The vessel plainly shows marks of aboriginal tools used in the shaping process. Finer tools were used on the inside of the bowl than on the outside, as illustrated by the scratches and gouges occurring on each surface. Several odd pieces of steatite were found in the pits and they are believed to have been brought to the site for use in pottery tempering but were never pulverized for this purpose.

The two marble-sized stones, one 20 mm in diameter and the other 26 mm, were found in separate excavations. The former was found in pit No. 3 and the latter elsewhere while testing. These stones appear to have been shaped by pecking, but their use is again speculation. They may have been for gaming.

Many flakes of quartz, quartzite, and rhyolite and a number of rejects and blanks were found in the pits. There were also a number of flakes and one crude point of limestone, all much weathered. Several pieces of worked Triassic sandstone and two nodules of a coarse conglomerate were found in the excavations. It is thought that this latter stone was used for tempering the grit-tempered sherds found here in a minority proportion.

ORGANIC MATERIALS

The only trace of organic material aside from charred wood found in the excavations consisted of two completely carbonized hickory nut shells, which were probably part of the inhabitants' diet.

BONE MATERIALS

One of the puzzling aspects of the site is the utter lack of worked or unworked human or animal bones in the refuse pits. No single sample large enough to identify has been found in any of the excavations. The only traces were very small bits of bone, none of which equaled the size of one's smallest fingernail. Even these tiny fragments were so fragile that they could rarely withstand separation from the soil that surrounded them. Two or three pieces showed signs of fire and consequently were in a somewhat better preserved state. In each pit excavated it was noticed that many hard-packed molds with considerably darker soil in their interiors existed throughout the fill. This suggests that something had at one time occupied these molds and had now completely decayed.

Bone of both animal and human is found in a comparatively good state of preservation on all other excavated sites not of this culture in the Potomac area. It is true that the mold marks may represent other organic compounds more readily affected by decay and that these aborigines possibly did not place animal bones in their refuse pits. This would certainly be contrary to the practices of all locally known woodland cultures. It might be that this soil is particularly acid and would dissolve bone structure more readily, but unless a much longer period of time is involved this is contradicted by the existence of the two other aboriginal village sites on this same island and presumably in the same soil structure. In both of these sites bone material is well preserved.

CONCLUSIONS

There are very few detailed descriptive reports dealing with particular sites along the Potomac above the District of Columbia. In the light of intermittent surveys and a rather considerable body of information derived therefrom, however, it appears that

the Selden Island site discussed herein represents a heretofore virtually unknown cultural horizon. The occurrence of steatite-tempered earthenware has long been known but the archeological complex of which it was characteristic has been unidentified.

Stearns's report (1940) on the Hughes site and Manson, McCord, and Griffin's report (1944) on the Keyser site describe Potomac Valley pottery assemblages in which shell-tempered ware predominates. Vessels are described as having wide mouths and rounded bottoms; several have loop handles or applique lugs below a modified rim which is often deeply notched with a cord-wrapped stick. In a minority proportion from each site are grit-tempered sherds which do not have lugs or handles but characteristically have collared rims and conical bottoms. This ware was found by the writer to predominate on several village sites in the immediate neighborhood of Selden Island. A third ware found at the Keyser site, designated "Potomac Creek Cord Impressed," is described as grit-tempered and conical-bottomed but not possessing collared rims, lugs, or handles (see also Stewart, 1939). In all these wares the application of a cord-wrapped paddle to the outer body surface is characteristic.

Steatite-tempered vessels from Selden Island appear to have had flat, or nearly flat, bottoms and plain unornamented rims, which were characterized by merely extending the cord roughening from the body of the vessel to the lip. The notched lip noted in shell-tempered ware appears to have been applied with a rather wide cord-wrapped stick while the notches on Selden Island pottery are a series of small indentations possibly applied with a very small bare stick or twig. The wide, flat lugs appearing on the sides of some steatite-tempered vessels differ greatly from the more expertly fashioned loop handles or rounded lugs appearing on shell-tempered ware. The steatite-tempered Selden Island sherds are generally easily distinguished from the more common shell- and grit-tempered wares on other sites of the Potomac Valley.

The absence of triangular arrowpoints and the presence of grooved axes instead of celts on the Selden Island site further distinguish this complex from others previously reported in the area.

The absence of sizable bone fragments in the refuse pits is contrary to findings at other Potomac Valley sites, and suggests greater antiquity rather than different habits of diet or methods of refuse disposal.

The extreme hardness of the pit fill and the eroded condition of some of the specimens seem to point similarly to a rather considerable antiquity.

On present evidence, the Selden Island site under consideration is certainly prehistoric. Though stratigraphic evidence is lacking, it appears to antedate the shell-tempered pottery horizon represented at the Hughes and Keyser sites. I suspect that it also antedates the known local grit-tempered wares, and may even represent the oldest pottery horizon in the locality. Until further excavations have been made at this and other related sites widely distributed throughout the Potomac piedmont area, the relationships of the complex must remain obscure. As to the people who were its authors, the complete lack of any skeletal material leaves their physical relationships unknown.

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ENTOMOLOGY.—*Species of beetles of the genus* Lactica *from the West Indies closely related to* L. tibialis (Olivier).[1] Doris H. Blake. (Communicated by Alan Stone.)

Olivier described *Altica tibialis* from a specimen in the Bosc collection from near Charleston, S. C. There are a great many pale yellow species of *Lactica* very similar in coloration to *tibialis* that occur in Mexico, Central and South America, and also in the West Indies. The purpose of this paper is to draw attention to some of the West Indian species, at least one of which has been confused with *tibialis*. These species, although very closely related, do show distinct differences in coloration, shape, and also in the internal structure of the genitalia. Most of the species here dealt with are from the Bahamas and Cuba, but from Dominica, which is a little more interesting in its differences, is also included. No doubt more species from other islands of the West Indies will come to light in the course of time.

Lactica tibialis (Olivier)

Figs. 2, 4

Altica tibialis Olivier, Ent. **6**: 702. 1808.
Altica ocreata Say, New Species found by Baradino in Louisiana: 7. New Harmony, 1832.
Monomacra tibialis DeJean Catalogue: 413. 1837.
Lactica tibialis Baly (not Olivier), H. Clark, Journ. Ent. **1**(6): 458. 1862.
Lactica tibialis Harold, Col. Hefte **13**: 90. 1875.

Lactica tibialis is represented in the U. S. National Museum collection by specimens from North and South Carolina, Georgia, Tennessee, Louisiana, Texas, Arkansas, and Missouri, and one is labeled Michigan. There are three specimens from Brownsville, Tex., that have a paler coloration. Instead of having entirely dark tibiae and tarsi, the tibiae in two of these are darkened only along the outer edge, and in the third specimen only the apices of the femora, tibiae, and tarsi are slightly darker. The aedeagus seems to have a sharper and narrower tip, although of the same shape. Possibly this is a southern race, but from the little material at hand I hesitate to make more than a mention of the differences.

[1] Received March 14, 1946.

Lactica religata (Jacq. du Val)

Fig. 1

Monomacra religata Jacq. du Val, Hist. phys. Cuba, Ins. **7**: 311. 1856; Suffrian, Arch. für Naturg. **34**: 193. 1868.
Lactica tibialis Gemminger and Harold, Catalogue **12**: 3499. 1876 (not *tibialis* Olivier).

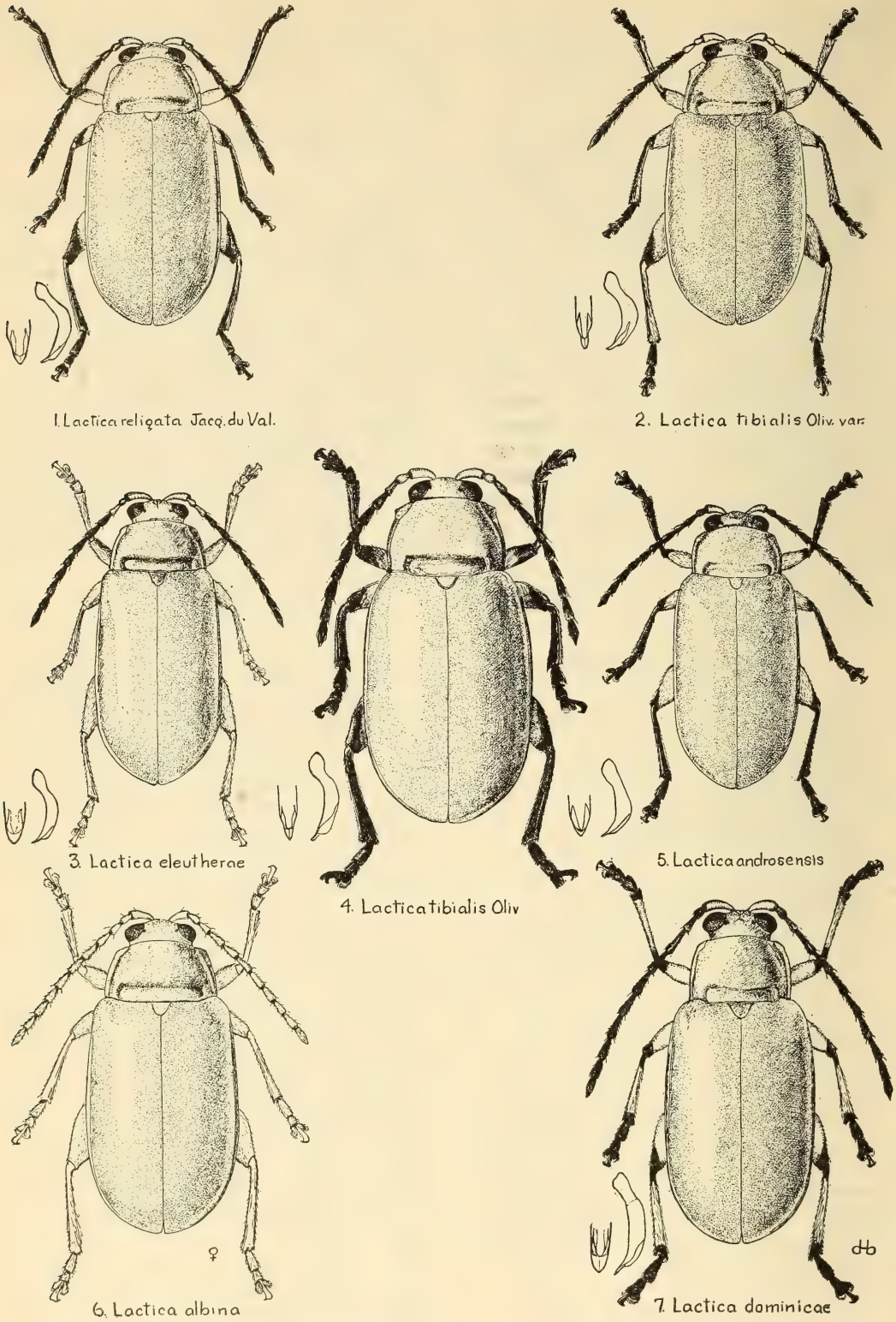
The name *Lactica tibialis* has been applied not only to the North American species but also to the Cuban one. The Cuban species is similarly colored but in general is a little smaller. There are also slight differences in the prothorax, the North American species having a proportionately wider one with a more marked obtuse angle anteriorly. Furthermore, the aedeagus of *tibialis* is very narrow and acute at the tip, whereas the tip of the Cuban species is more broadly rounded.

Lactica dominicae, n. sp.

Fig. 7

Elongate-oblong, pale yellow, impunctate, faintly shining, mouth parts darker, antennae except three basal joints dark, legs with dark apices to femora and tibiae and tarsi dark; thorax with sides almost straight, very little widened at base, antennae extending nearly to the middle of the elytra.

Head with interocular space less than half width of head; eyes large; frontal tubercles distinct, a little produced; interantennal area sharp and keel-shaped, a large puncture grouped with two or more smaller punctures on each side of vertex near the eye; mouth parts tinged with dark. Antennae long and slender, extending to the middle of the elytra, except for the basal joints entirely dark, the first joint entirely pale, the second and third deepening in color; fourth longest, 5, 6, and 7 subequal and nearly as long as fourth, the remainder gradually shortening. Prothorax about a third wider than long with the sides nearly straight, very little wider at base than anteriorly; basal sulcus deep and distinct throughout. Elytra with small humeri, elongate, smooth, faintly shining. Body beneath entirely pale, lightly pubescent. Legs pale with apices of femora and



FIGS. 1–7.—West Indian species of *Lactica*.

tibiae and tarsi dark. Length 4 mm; width 2 mm.

Type male, U.S.N.M. No. 57877.

Type locality.—Saltoun Estate, 800 feet altitude, Dominica, B.W.I., collected June 30, 1941, by R. G. Fennah.

Remarks.—The distinguishing character of this species is the thorax with its nearly straight sides, and also the unusually long antennae.

Lactica eleutherae, n. sp.

Fig. 3

Elongate-oblong, shining, pale yellow with dark antennae. Basal sulcus on thorax deeply impressed.

Head with interocular space approximately half width of head, frontal tubercles distinct with a depression on each side of them on the vertex, a deep puncture also near the eye; interantennal area not produced but flat; head entirely pale. Antennae with the three basal joints pale, remainder dark and subequal, not reaching the middle of the elytra. Prothorax almost twice as wide as long with slightly rounded sides, a little broader at the base; a deeply impressed basal sulcus. Elytra shining, impunctate, smooth, with small humeri. Body beneath entirely pale, shining, lightly pubescent. Legs pale. Length 3.2–3.4 mm; width 1.5 mm.

Type male and one paratype, also male, U.S.N.M. No. 57878.

Type locality.—Eleuthera Island, Bahamas, collected by H. F. Wickham July 9–15.

Remarks.—This species differs from the Cuban one by having entirely pale legs. It is also more highly polished and has a more deeply impressed basal sulcus on the prothorax.

Lactica albina, n. sp.

Fig. 6

Elongate-oblong, impunctate, faintly shining, entirely pale yellow without dark markings on legs or antennae.

Head with interocular space approximately half width of head; frontal tubercles rather flat and indistinct, interantennal area not sharply keeled but flat, very little produced; a large puncture on each side of vertex near eye; entirely pale. Antennae not extending to the middle of the elytra, entirely pale, fourth and fifth joints subequal and a little longer than the remainder, all joints subequal. Prothorax more than a third wider than long with slightly rounded sides, broadening a little towards base; basal sulcus clearly marked. Elytra smooth, impunctate, faintly shining, humeri small. Body beneath pale, shining, nearly glabrous. Legs entirely pale. Length 3.9 mm; width 1.8 mm.

Type female, U.S.N.M. No. 57879.

Type locality.—Egg Island, Bahamas, collected on May 13 by H. F. Wickham.

Remarks.—This is the only species of the group from the West Indies that is entirely pale. Unfortunately, no male has been examined.

Lactica androsensis, n. sp.

Fig. 5

Elongate-oblong, shining, impunctate, pale yellow with all except the basal joint of the antennae dark, apex of femora, tibiae, and tarsi dark.

Head with interocular space approximately half its width, polished pale yellow with mouth parts tending to be darker; frontal tubercles with a depression between and on either side of them; interantennal area flat, the usual large puncture near the eye. Antennae not extending to the middle of the elytra, all but the basal joint dark, joints 4–11 subequal. Prothorax not quite twice as broad as long, with sides slightly arcuate, a little wider at base; basal sulcus clearly marked. Elytra smooth, pale, polished, humeral prominences small. Body beneath entirely pale and lightly pubescent. Legs with the apex of the femora, and the tibiae and tarsi dark. Length 3.2–3.7 mm; width 1.6–1.7 mm.

Type male (M.C.Z. No. 27374) and 2 paratypes (1 in U.S.N.M. No. 57880).

Type locality.—Andros Island, Bahamas, collected Aug. 1–10, 1904 by Barber (? Thomas Barbour).

Remarks.—In coloration this is very much like the Cuban species and *tibialis*, although the femora are darkened only at the tip, whereas in the other two the dark extends farther back. The aedeagus is different from either.

ENTOMOLOGY.—*The* Aedes (Finlaya) niveus *subgroup of Oriental mosquitoes.*[1]

KENNETH L. KNIGHT, Lt. Comdr., H(S), U.S.N.R.[2] (Communicated by ALAN STONE.)

By Edwards's[3] classification, those mosquitoes in the subgenus *Finlaya* with dark hind tarsi (including *unicinctus* Edwards, which has the first segment basally banded) are all included in what he terms "Group H." A distinct section of this group is represented by *niveus* (Ludlow) and is characterized by having at least the anterior two-thirds of the scutum covered with white scales (may be more or less divided medially in the fe nale; in *idjenensis* Brug the light-colored scutal scales are pale golden) and by lacking femoral knee spots. At present there are seven species described in the *niveus* subgroup. Of these, specimens of *albolateralis* (Theobald) (male only), *niveus* (Ludlow), and *novoniveus* Barrand (male only) have been examined by the author. For comparison with *idjenensis* Brug, *pseudoniveus* (Theobald) (Borneo, Singapore, Sumatra), *niveoides* Barrand (India, Indo-China, Sumatra, Java), and *alboniveus* Barrand (Java, eastern Himalayas), the literature descriptions were utilized. Larvae of only *niveus* were seen.

In this paper four new species are described; and the possibility of a literature description of *niveus* being a new species is pointed out.

KEY TO FEMALES OF THE NIVEUS SUBGROUP

1. A patch of broad white scales on *ppn*.....2
   No broad white scales on *ppn*.....3
2. Light-scaled scutal areas pale golden.....
   .....*idjenensis* Brug
   Light-scaled scutal areas white. *niveus* of Feng[4]
3. A silvery spot in middle of anterior surface of midfemur.....*pseudoniveus* (Theobald)
   No silvery spot in middle of anterior surface of midfemur (however, there may be a median elongate pale marking ventrally on anterior surface).....4
4. Extent of apical dark area of hind femur greatly reduced laterally, incomplete or nearly so ventrally; midfemur largely pale on posterior surface.....5
   Apical dark area occupies one-fourth or more of hind femur, lateral and ventral extent little or not reduced.....6
5. White scales present along margins of prescutellar bare space; apical dark area of hind femur broken ventrally.....*saperoi*, n. sp.
   No white scales present around prescutellar bare space; apical dark area of hind femur usually thinly connected ventrally.....
   .....*dorseyi*, n. sp.
6. Scutal white scaled area not extending to lateral margin over most of paratergite; lateral white scaled areas may be broadly connected anteriorly.....*laoagensis*, n. sp.
   Scutal white scaled area extending along lateral margin to wing base, or at least to level of prealar region.....7
7. Scutal white scaled area not broken medially, posterior margin may be slightly concave
   .....*niveus* (Ludlow)
   niveoides Barraud
   novoniveus Barraud[5]
   alboniveus Barraud
   Scutal white scaled area broken by a broad longitudinal median band of dark scales, frequently a line of connecting scales anteriorly
  8
8. White scales present along margins of prescutellar bare space; midfemur extensively pale posteriorly, and usually with some ventral pale scaling on the anterior aspect.....
   .....*albolateralis* (Theobald)
   No white scales present around prescutellar bare space; midfemur dark, a few ventrobasal pale scales on posterior surface.....
   .....*lacteus*, n. sp

KEY TO THE NIVEUS SUBGROUP BASED ON MALE GENITALIA[6]

1. Sclerotized ridge on dorsal (before rotation) inner basal surface of basistyle with an apical

[1] Received May 2, 1946. The collections reported on here were made under the auspices of U. S. Naval Medical Research Unit no. 2. The material was worked up in space furnished by the Division of Insects, U. S. National Museum. Additional specimens were made available from the museum collections through the courtesy of Dr. Alan Stone.

[2] Research Division, Bureau of Medicine and Surgery, U. S. Navy Department.

[3] EDWARDS, F. W. *Genera insectorum. Culicidae*, fasc. 173: 154. Brussels, 1932.

[4] *Aedes* (*Finlaya*) *niveus* Ludlow. FENG, L., *The tree hole species of mosquitoes of Peiping, China.* Chinese Med. Journ., Suppl. 2: 512. 1938. This is apparently a previously undescribed species.

[5] According to Barraud (*Fauna of British India, Diptera*, 5: 205. 1934) the females of these species are indistinguishable.

[6] The males of *pseudoniveus* and *idjenensis* are undescribed. The male genitalia of Feng's *niveus* are not sufficiently described to be placed in this key.

elbowed spine and a lateral stout hair..... ..... *alboniveus* Barraud

This ridge without an apical elbowed spine..2

2. Dorsal basal portion of basistyle with a clump of specialized scales (to be distinguished from normal abdominal type scales).....3

Dorsal basal portion of basistyle with a clump of long setae, none of them striated (one specimen of *saperoi* had 2 setae striated)..7

3. Inner dorsal area of basistyle with a broad band of uniform (except apically) stiff short setae.....4

Inner dorsal area of basistyle with a row of stiff bent setae on inner margin, a few smaller setae behind these.....6

4. Dorsal basal scale clump of basistyle with some of scales very broad, others slender and elongate (Fig. 2); claspette blade distinctly enlarged medially, enlarged portion clear (Fig. 10)..... *lacteus*, n. sp.

Dorsal basal scale clump of basistyle with scales setiform; claspette blade evenly and only slightly swollen to middle, of uniform texture.....5

5. Inner dorsal area of basistyle with short stiff setae extending laterally to longer lateral setae (Fig. 5)..... *niveus* (Ludlow)

Inner dorsal area of basistyle with a band of short stiff setae on inner margin, a bare area present between these and longer lateral setae (Fig. 4)..... *dorseyi*, n. sp.

6. Dorsal basal scale clump of basistyle with scales of several different lengths, shorter ones obovate (Fig. 6); claspette blade distinctly widened medially, enlarged portion clear (Fig. 8)..... *albolateralis* (Theobald)

Dorsal basal scale clump with scales narrow, elongate and most of them of rather uniform length (Fig. 3); claspette blade only slightly swollen medially, of uniform texture (Fig. 12)..... *laoagensis*, n. sp.

7. Blade of claspette widening only slightly to the middle, of uniform texture. *niveoides* Barraud

Blade of claspette noticeably enlarged medially 8

8. Inner dorsal area of basistyle largely free of setae medially (Fig. 1); appendage of dististyle over three-fourths as long as dististyle..... *saperoi*, n. sp.

Inner dorsal area of basistyle rather uniformly covered with short bent setae; appendage of dististyle approximately one-half length of dististyle..... *novoniveus* Barrand

KEY TO THE LARVAE OF THE NIVEUS SUBGROUP[7]

1. Comb teeth fringed to just before apex; ventral brush with 10 or more tufts.....2

Comb teeth not fringed beyond middle; ventral brush with 8 tufts.....4

2. Most of comb teeth with bases united by a sclerotized area, 10–12 in number (Fig. 17); mentum with 6–7 lateral teeth (Fig. 20)... ..... *dorseyi*, n. sp.

Comb teeth not connected basally by a sclerotized area, 12–17 in number; mentum with 8–10 lateral teeth.....3

3. Ventral brush with 12 tufts; pecten teeth uniformly pigmented (Fig. 15)... *lacteus*, n. sp.

Ventral brush with 10 tufts; pecten teeth pale apically (Fig. 16)..... *niveus* (Ludlow)

4. Basal pecten teeth the largest..... ..... *novoniveus* Barraud

Basal pecten teeth the smallest.....5

5. Siphon index 4–5; comb teeth fringed at extreme base only..... *niveoides* Barraud

Siphon index 3.5 or less.....6

6. Head hair 5 with 10–16 branches; tufts of ventral brush 4–7 branched; acus usually thinly attached (Fig. 13)..... *saperoi*, n. sp.

Head hair 5 with 5–11 branches; tufts of ventral brush 2–4 branched;[8] acus detached..7

7. Antennal tuft 9–12 branched; subterminal antennal hairs distinctly unequal in length ..... *alboniveus* Barraud

Antennal tuft 5–7 branched.....8

8. Siphon index approximately 2; dorsal anal gills about 1.5 times the length of the anal plate (Fig. 14)..... *laoagensis*, n. sp.

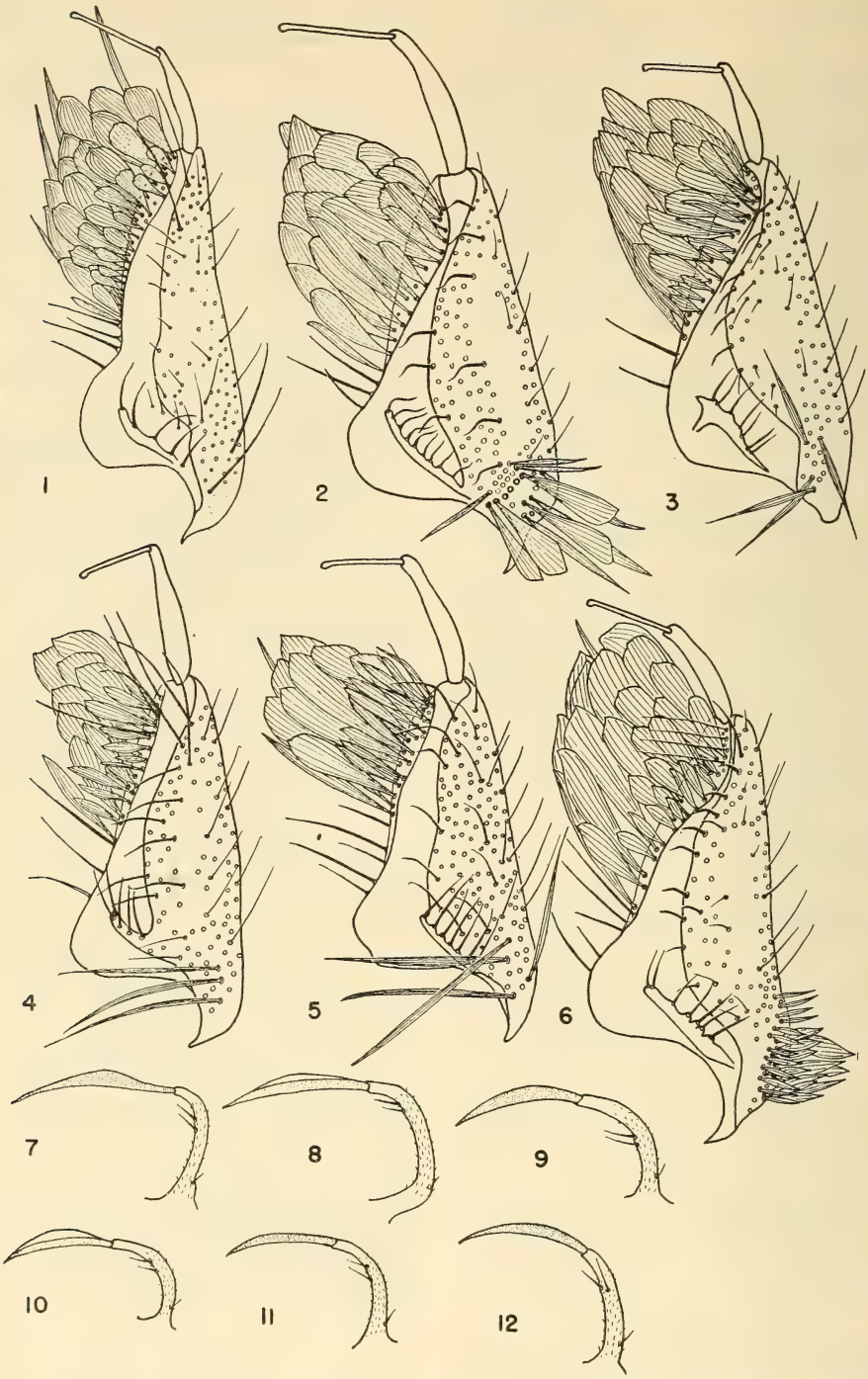
Siphon index 3–3.5; dorsal anal gills (according to Barraud, 1934) about the length of the longer ventral brush hairs..... ..... *albolateralis* (Theobald)

Aedes (Finlaya) saperoi, n. sp.

Male.—Wing: 2½ mm. *Head:* Proboscis black, longer than front femur. Palpus black, slightly shorter than proboscis, a mesal ventral line of short recumbent dark hairs on the second long segment, long black hairs at apex of this segment and along the 2 terminal segments, apical segment slightly shorter than the subapical. Vertex with broad yellowish-white scales, except in the lateral corner and along the eye margin where they are white, a narrow area of yellowish-white forked upright scales on the nape. *Thorax:* Scutal integument dark; covered with broadened curved white scales (except for a narrow submedian longitudinal band of straight narrow scales) from just before the wing base of the anterior margin of the

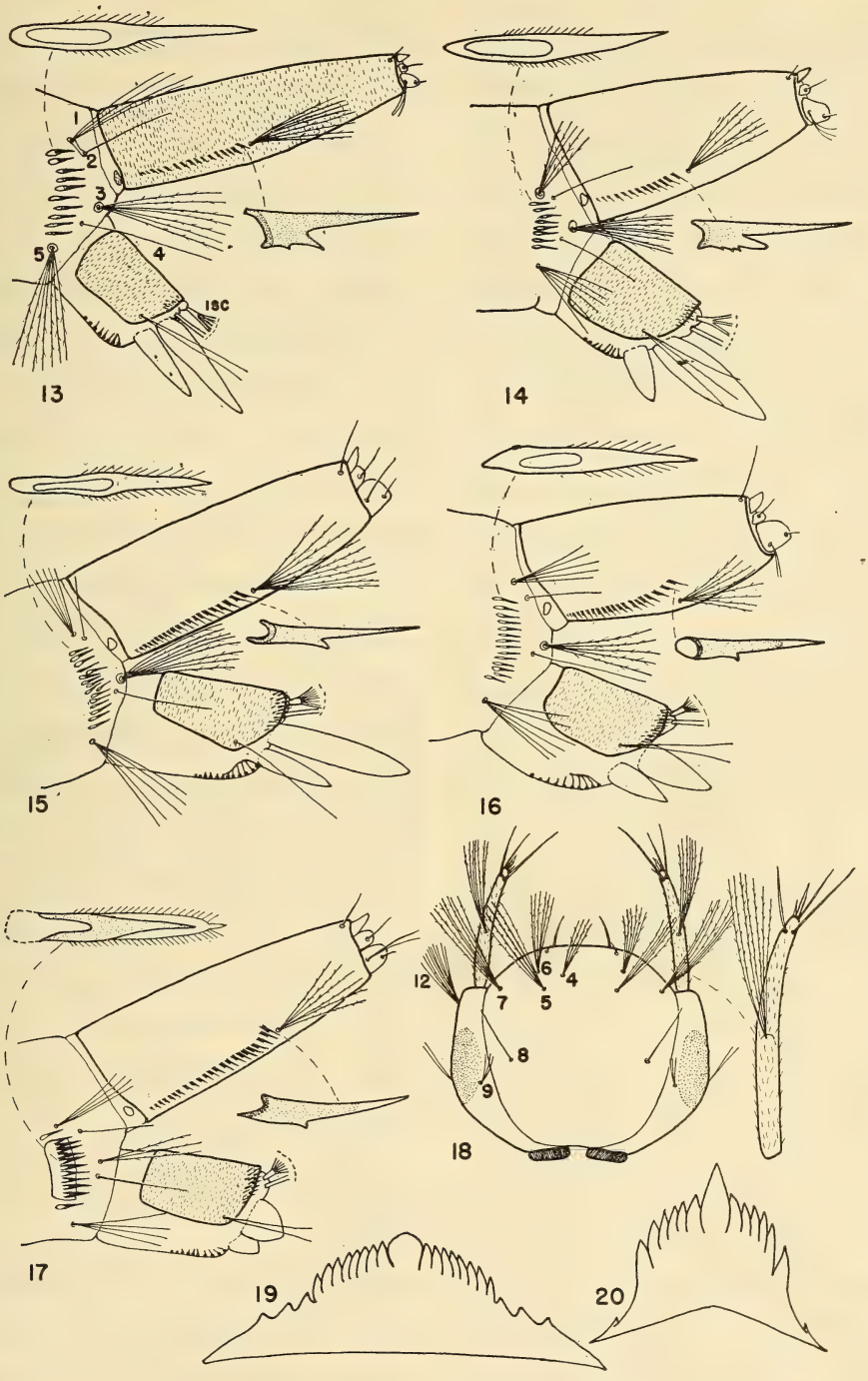
[7] The larvae of *pseudoniveus* and *idjenensis* are undescribed. The larva of Feng's *niveus* can not be taken beyond point 6 in the key, because of the inadequacy of the description. However, it is described as having the dorsal anal gills approximately equal to the anal plate in length. This would separate it from the remaining species.

[8] There are conflicting literature descriptions on this point for *alboniveus;* this is also true of the number of tufts in the ventral brush.



FIGS. 1–6.—Inner dorsal aspect of dissected basistyle of male genitalia of *Aedes* (*Finlaya*) (setal rings indicate location of omitted setae): 1, *A. saperoi;* 2. *A. lacteus;* 3. *A. laoagensis;* 4, *A. dorseyi;* 5. *A. niveus;* 6, *A. albolateralis.*

FIGS. 7–12.—Lateral aspect of dissected claspette: 7, *A. saperoi;* 8, *A. albolateralis;* 9, *A. niveus;* 10, *A. lucteus;* 11, *A. dorseyi;* 12, *A. laoagensis.*



Figs. 13–17.—Lateral aspect of larval terminal segments of *Aedes* (*Finlaya*) (ventral brush omitted): 13, *A. saperoi;* 14, *A. laoagensis;* 15, *A. lacteus;* 16, *A. niveus;* 17, *A. dorseyi.*
Fig. 18.— Dorsal aspect of larval head, *A. dorseyi.*
Figs. 19, 20.—Dorsal aspect of the mentum: 19, *A. saperoi;* 20, *A. dorseyi.*

scutum, the white scales extending to the lateral margin along their entire extent; posterior portion of scutum with narrow and broadened curved black scales, an area of white scales around the prescutellar bare space. Scutellar lobes clothed with broad grayish-white scales. *Apn* and *ppn* blackish brown, *apn* with broad white scales, *ppn* bare (one side of holotype possesses one broad dark scale dorsally). Pleuron blackish brown, a patch of broad white scales present on each of the following: Propleuron, prealar area, upper sternopleuron, and lower posterior border of the sternopleuron and the mesepimeron. Coxae and trochanters pale, covered with broad white scales, the forecoxa with a few dark scales intermingled. Forefemur dark, anterior aspect with a basal ventral line of pale scales, posterior aspect with a median pale band from near base to apex, broadest on basal half and extending to dorsal margin there, a separate white basal patch present; mid femur with anterior aspect dark except for complete ventral margin and the dorsal basal margin, posterior aspect pale except for the dorsal apical half; hind femur creamy white, apical two-fifths black, the black area incomplete on the ventroanterior and ventral aspects. Tibiae and tarsi dark. Tarsal claws of fore and mid legs unequal, both toothed; of hind leg equal, simple. Wings dark scaled. Halter pale, knob with dark and pale scales. *Abdomen:* Tergites dark scaled; tergite I with a broad bare hairy sublateral area, lateral margin with a patch of white scales; II with a basal lateral white patch that becomes subbasal medially, broadly incomplete medially; complete basal white bands on IV–VII, these bands widest laterally, some dark scales basad of the bands on each segment; a posterior lateral scaleless area on tergites II–V, these areas with numerous long pale hairs, a line of similar hairs on posterior margin of each segment. Sternites dark scaled with basal white bands. *Genitalia* (Figs. 1 and 7): Basistyle with median portion of inner dorsal surface (before rotation) largely free of setae; basally the dorsal inner surface bears a patch of elongate thickened setae (under high power, fine striae are apparently present on 2 of these in the holotype, indicating that they are possibly scales; this was not noted in the other specimens); a patch of broad dusky scales on the inner ventral margin, 2–3 of the more external of these elongated and narrowed; a narrow sclerotized ridge with 4–5 stout setae extends ventrally from dorsal inner basal margin of basistyle. Dististyle appendage 0.76–0.83 (3 specimens) as long as the dististyle. Blade of claspette distinctly widened medially, uniform in texture. Ninth tergite with 1–3 broadened stout setae on each lobe.

Female.—Wing: 3 mm. Differs from the male as follows: Palpus approximately one-fourth to one-fifth as long as the proboscis. Torus with a few fine black scales on the inner aspect (these possibly occur on the male but could not be seen). Vertex dark scaled, a band of white along the eyes, the band enlarged medially, a large white area in the lateral corner, the forked upright scales dark. Scutum with the anterior white region broken by a broad median longitudinal dark scaled area, a narrow area of white scales connecting the lateral white areas along the anterior margin, the prescutellar bare space with white scales along the lateral margins and sometimes across the front. Midfemur with ventral pale area of anterior aspect widened in the middle, dorsal margin may be all dark. Tarsal claws of fore and mid legs equal, toothed; of hind leg equal, simple. Abdominal tergites without lateral scaleless areas on tergites (that of tergite I being sublateral).

A slight degree of color variation occurs in this species. The scutellar scales in the female may be a brownish gray, but even then there are usually a few white scales on the mid lobe. The pale markings of the femora occasionally exhibit a slight reduction, the most striking case of which was a male that had all the posterior surface of the midfemur dark except the ventral margin. However, in none of the material studied was the black on the hind femur complete ventrally. In one female, the dorsal abdominal bands were narrowly interrupted medially.

Larva.—Head: Antenna with hair tuft inserted before middle, 10–17-branched; subterminal bristles equal. No median mouth brush hairs were seen with comblike tips. Head hair 4 with 9–15 branches, 5 with 10–16, 6 with 7–15, 7 with 9–15, 8 with 2–3, 9 with 5–8, 12 with 18–25. Mentum (Fig. 19) with 10–11 lateral teeth. *Abdomen* (Fig. 13): Some of the hairs thinly stellate in type. Lateral hairs of segments I–VI with 2 branches. Pentad hair 1 with 3–6 branches, 3 with 7–8 (one specimen

with 11), 5 with 6–7. Comb teeth 8–12 in number, with fine lateral basal fringe that extends just onto the shaft. Siphon with surface roughened by interrupted transverse striations; index 3–3.5; acus usually thinly attached; hair-tuft 5–9 branched; 14–24 pecten teeth, basal teeth the smallest, evenly pigmented (occasionally apical teeth are seen with paler tips), a stout lateral denticle, 1–3 minute spines frequently present basally; length of apico-dorsal hair less than one-half the width of the siphon apex. Anal plate with a patch of minute laterocaudal spinules, lateral hair 2–5 branched, *isc* 3–5. Ventral brush with 8 tufts, each tuft 4–7 branched. Anal gills tapered to a rounded tip, dorsal pair 1.4–2.0 times longer than the ventral pair and 1.3–1.7 times longer than the anal plate (in one specimen, the dorsal gills were slightly shorter than the anal plate).

Types.—Holotype: Male, with larval and pupal skins, and dissected genitalia (U.S.N.M. No. 57919), Subic Bay, Luzón, Philippines, June 27, 1945 (F. E. Zedeck and E. S. Zolik), reared from a bamboo stump. *Paratypes* (4 males, 6 females, all from Subic Bay, Luzón): 5 females with associated larval and pupal skins, 2 males without associations, same data as for holotype; 1 male and 2 females, July 7, 1945 (M. J. MacMillan), reared from a tree hole; 1 male and 1 female, August 13, 1945 (L. A. Rozeboom and M. J. MacMillan), reared from bamboo stump. Paratypes deposited in U. S. National Museum and British Museum.

This species is dedicated to Capt. J. J. Sapero (MC) USN, whose cooperation has done much to further Pacific mosquito studies.

Aedes (Finlaya) lacteus, n. sp.

Male.—Wing: 2½ mm. Differs from the description of *saperoi* as follows: Vertex with broad dark scales (appear paler in some lights), pale scales along the eyes and in the lateral corner, the upright forked scales dark. Scutum with no pale scales around the prescutellar bare space. Scutellar lobes clothed with broad, dark-brown scales. Forefemur dark anteriorly, posterior aspect with a broad median pale band on basal half; midfemur all dark except for a few ventrobasal pale scales on the posterior aspect; hind femur white, a few basal dark scales, about apical two-fifths completely dark scaled. Halter with knob dark scaled. *Genitalia* (Figs. 2 and 10): Inner dorsal margin of basistyle with a broad band of uniform short stout curved setae, the area immediately external to this band free of setae; basally the dorsal inner surface bears a clump of narrow acutely tapered scales, immediately basad to these is a transverse line of 6 very broad scales and a clump of about 6 elongate mixed slender and broad scales, the slender ones being acutely tapered and longer than the broad scales; the sclerotized ridge on the dorsal inner basal margin of the basistyle with 10–12 stout setae. Dististyle appendage 0.73 as long as the dististyle. Blade of claspette distinctly enlarged medially, the enlarged portion being clear. Ninth tergite with 3 bristles on each lobe.

Female.—Wing: 3 mm. Differs from the female description of *saperoi* as follows: Palpus very small, approximately one-eighth as long as the proboscis. Scutum with the broad median band of dark scales extended to anterior margin, the 2 lateral white-scaled areas not connected, no white scales around the prescutellar bare space. Scutellar lobes covered with broad dark scales. Forefemur dark anteriorly, posterior aspect with a broad median pale band on basal half; midfemur dark, a few ventrobasal pale scales on the posterior aspect; hind femur white, a few basal dark scales, about apical one-third all dark. Halteres with knob dark scaled. Abdominal tergites without complete bands (possibly some shrinkage has occurred).

Larva.—Head: Antennal shaft with hair tuft just before middle, 6–8-branched; subterminal bristles distinctly subequal. Median mouthbrush hairs with comblike tips. Head hair 4 with 9–13 branches, 5 with 9–11, 6 with 8–9, 7 with 10–12, 8 with 1–2, 9 with 2–4, 12 with 6–8 (main branches only). Mentum with 9–10 lateral teeth. *Abdomen* (Fig. 15): No stellate hairs. Dorsolateral hair of I with about 6 branches, the lateral hair with 2; lateral hair of II with 5–6; of III–VI with 2. Pentad hair 1 with about 5 branches, 3 with 8–10, 5 with 5–7. Comb teeth 13–17 in number, broadened, finely fringed to just before apex. Siphon dark with apical fifth pale; smooth; index about 3; small detached acus; hair tuft 11-branched; 20–24 very dark slender pecten teeth, basal teeth the smallest, evenly pigmented, a stout lateral denticle; length of apicodorsal hair nearly equal to width of siphon apex. Anal plate with a prominent patch of laterocaudal spines, lateral hair 1–2-branched, *isc* 8–10.

Ventral brush with 12 tufts, each tuft 6–14-branched. Anal gills somewhat lanceolate, dorsal pair 1.8–2.3 times longer than the ventral pair and about 1.2 times longer than the anal plate.

Types.—Holotype: Male, with dissected genitalia (U.S.N.M. No. 57920), Cape Melville, Balabac Island, Philippines, June 1945 (Jean L. Laffoon and D. R. Johnson), reared from a tree hole. *Paratypes:* 1 female, 2 larvae, same data as for holotype. Deposited in U. S. National Museum.

Discussion.—A female specimen in the U. S. National Museum from Parang, Mindanao (J. H. Paullus), is possibly this species, but in the absence of a male positive identification is not possible.

Aedes (Finlaya) laoagensis, n. sp.

Male.—Wing: 2–2.5 mm. Differs from the description of *saperoi* as follows: Vertex dusky medially, remainder pale, upright forked scales dark. Scutum with only a very few pale scales along the prescutellar bare space (this area rubbed in holotype). Scutellar lobes all dark scaled. Forefemur dark, with a median pale area on the posterior basal half, the pale area reaching the dorsal margin basally; midfemur dark, with a small ventral line of pale scales extending from near base to just beyond middle on posterior aspect; hind femur white with about apical one-third dark. Halter knob dark scaled. Although the holotype has the abdominal tergites banded as in *saperoi*, the male from Baguio has them incomplete on at least the first six segments. *Genitalia* (Figs. 3 and 12): Basistyle with a line of short stiff curved setae along inner dorsal margin, followed laterally by a line of thinner setae, a bare area between these and the setae of the lateral margin; basally the dorsal inner surface bears a clump of elongate narrowly lanceolate scales (the male from Baguio has a few of the scales noticeably shorter than the others but not differently shaped; this area in the holotype appears to have lost some scales); the sclerotized ridge on the dorsal inner basal portion of the basistyle with approximately 7 slender setae. Dististyle appendage 0.70–0.72 as long as the dististyle. Blade of claspette not noticeably enlarged medially, uniform in texture. Ninth tergite with 1–3 bristles on each lobe.

Female.—Wing: 2.3 mm. Differs from the female description of *saperoi* as follows: Palpus approximately one-fifth as long as the proboscis. Torus bare. Lateral white-scaled areas of scutum broadly connected anteriorly, lateral margin of scutum before wing base dark scaled halfway to scutal angle (nearly all of margin along paratergite dark scaled). No white scales around the prescutellar bare space. Scutellar lobes dark scaled. Forefemur dark, pale scales on basal median posterior aspect; midfemur dark, broad pale area ventrally on basal half of posterior aspect; hind femur white; apical one-third all dark.

Larva.—Head: Antenna with hair tuft inserted before middle, 5–6-branched; subterminal bristles equal. Inner mouth-brush hairs with very small fine comblike tips. Head hair 4 with 8 branches, 5 with 6–7, 6 with 5–6, 7 with 8–9, 8 with 2, 9 with 4–6, and 12 with 11–12. Mentum with 9 lateral teeth. *Abdomen* (Fig. 14): Dorsolateral hair of I with 3 branches, lateral hair with 2; lateral hairs of II–VI with 2 branches. Pentad hair 1 with 5–6 branches, 3 with 7–8; 5 with 6. Comb teeth 8 in number, with lateral fringe on basal half. Siphon largely smooth, transverse striations present basally; index about 2; detached acus; hair tuft 6–7-branched; 12–13 pecten teeth, basal teeth the smallest, evenly pigmented, a stout lateral denticle, 1–3 smaller spines generally present; length of apicodorsal hair distinctly less than one-half the width of the siphon apex. Anal plate with a patch of short laterocaudal spines, lateral hair 3-branched, *isc* 3-branched. Ventral brush with 8 tufts, each tuft 3–4-branched. Anal gills broadly lanceolate, dorsal pair about 2.0 times longer than the vental pair and 1.5 times longer than the anal plate.

Types.—Holotype: Male, with dissected genitalia (U.S.N.M. No. 57921), Laoag, Ilocos Norte Province, Luzón, Philippines, June 1945 (Harry Hoogstraal), reared from a tree hole. *Paratypes:* 1 female, 1 mature and 1 immature larva, same data as for holotype; 1 male, Baguio, Luzón, August 1945 (S. E. Shields), reared from a tree hole. Deposited in U. S. National Museum.

Discussion.—On the basis of the adult key in this paper, 3 female specimens (2 with associated larval skins) reared from tree holes at Subic Bay and San Fernando, Luzón (M. J. MacMillan), appear to be this species but differ slightly in adult and larval characters.

These differences could quite possibly be due to the species being based on such scanty material. Two of the adults have the white-scaled scutal area complete, while the third has this area medially broken by a dark-scaled area as in the type female of *laoagensis*. Other differences are: Wing, 3 mm; torus with minute black scales. The larva differs as follows: Head hair 4 with 8–10 branches, 5 with 6–8, 6 with 4–7, 8 with 2–3, and 12 with 12–16. Mentum with 9–10 lateral teeth. Comb teeth 8–10 in number. Siphon index 2.7 (from skins); acus attached; hair tuft 4–6-branched; 14–21 pecten teeth. Lateral hair 2–4-branched. Dorsal anal gills approximately equal to the anal plate in length.

In the U. S. National Museum, there are 4 female specimens (Luzón: Rizal, Laguna, and Tayabas Provinces) which also would appear to be *laoagensis* on the basis of dark scaling on the lateral scutal margin above the paratergite.

In the absence of males and because of the slight differences given above, none of this material was included in the type series.

Aedes (Finlaya) dorseyi, n. sp.

Male.—Wing 2.5 mm. Differs from the description of *saperoi* as follows: Vertex with brownish-yellow scales (Median area darker in some lights) except in the lateral corners and along eye margins, where they are white; forked uprights pale. Scutum with no white scales around the prescutellar bare space. Lateral scutellar lobes with broad dark scales, median lobe with broad pale scales. Prealar area bare (one broad white scale on one side) Coxae all pale scaled. Forefemur with anterior aspect dark on apical half or more, pale basally, posterior aspect pale except for dorsoapical portion; midfemur with anterior aspect dark, posterior aspect pale yellow except dorsoapical margin, dorsal and ventral margins pale; hind femur pale, apical one-sixth dark scaled dorsally, the dark scaling reduced laterally and nearly interrupted ventrally. *Genitalia* (Figs. 4 and 11): Inner dorsal margin of basistyle with a band of stiff curved setae, those near the apex being considerably longer than the others; basally the inner surface bears a clump of very long, extremely narrow scales; the sclerotized ridge on the dorsal inner basal margin with 5–7 stout setae. Dististyle appendage 0.50 as long as the dististyle. Blade of claspette not noticeably enlarged medially, uniform in texture. Ninth tergite with 2–4 stout setae on each lobe.

Female.—Wing: 2.66 mm. Differs from the female description of *saperoi* as follows: Palpus approximately one-sixth as long as the proboscis. Torus bare. Forked upright scales of vertex yellowish brown. The lateral white-scaled areas of the scutum not connected anteriorly; no pale scales around the prescutellar bare space. Scutellar lobes with broad dark scales, mid lobe may be partially pale-scaled. Femora marked as in the male (*dorseyi*), dark-scaled apex of hind femur may be narrowly interrupted ventrally. Halter dark-scaled, or with dark and light scales. Abdominal tergites V–VIII with complete basal bands.

Larva.—Head (Fig. 18): Spicules of antennal shaft distinctly finer than in the other species described in this paper; hair tuft before middle 5–7-branched, subterminal bristles subequal. No mouth-brush hairs were seen with comblike tips. Head hair 4 with 4–7 branches, 5 with 3–7, 6 with 4–6, 7 with 7–10, 8 single, 9 with 3–4, 12 with about 9 main branches. Mentum (Fig. 20) with 6–7 lateral teeth. *Abdomen* (Fig. 17): With sparse stout stellate tufts on I and II. Dorsolateral hair of I with 4 branches, lateral hair with 1–2; lateral hair of II with 3; lateral hairs of III–VI double (once 3). Pentad hair 1 with 3–5 branches, 3 with 3–5, 5 with 4. Comb teeth 10–12 in number, with pale lateral fringe to just before apex, all connected basally by a sclerotized area except frequently the end one. Siphon smooth; index about 2.5; small detached acus present; hair tuft 5–7-branched; 20–25 pecten teeth, basal teeth the smallest, tips pale, a stout lateral denticle, 1–3 minute spines frequently present basally; length of apicodorsal hair approximately one-half the width of the siphon apex. Anal plate with a prominent laterocaudal patch of spines; lateral hair 2–3 branched; *isc* about 7-branched. Ventral brush with 10 tufts, each tuft 4–7-branched. Anal gills somewhat budlike (only visible in one specimen) in shape, dorsal pair 1.3 times longer than the ventral pair and 0.5 as long as the anal plate.

Types.—Holotype: Male, with dissected genitalia (U.S.N.M. No. 57922), Garakayo, Palau Islands, August 1945 (C. K. Dorsey and H. Dybas), reared from a tree hole. *Paratypes:* 2 larvae, same data as holotype; 5 males, 5 females, 3 larvae, Peleliu, Palau Islands, March

and August 1945 (C. K. Dorsey), the larvae reared from a steel drum and a tree hole. Paratypes deposited in U. S. National Museum.

This is the first member of the *niveus* subgroup to be described from the Australasian region.

This species is dedicated to one of the collectors.

Aedes (Finlaya) niveus (Ludlow)

1903. *Stegomyia niveus* Ludlow, Journ. New York Ent. Soc. 11(3): 139. (Female.) (Type locality: Oras, Samar. Female lectotype in Brit. Mus.; lectoparatypes (all females) in U. S. Nat. Mus.)

1910. *Stegomyia pseudonivea* Theobald, Mon. Cul. 5: 176. (Male only.) (No pertinent details of male genitalia. Andaman Is. specimen in Brit. Mus. The female of *pseudonivea*, described in 1905, is another species.)

1931. *Aedes* (*Finlaya*) *niveus* (typus) (Ludlow), Brug, Arch. Hydrobiol. Supp.-Bd. 9: 25. (First association of male genitalia and larva. Sumatra. Bali.)

Male.—Wing: 2.75. Differs from the description of *lacteus* as follows: A few broad dark scales along dorsal margin of *ppn* (rarely a number of these scales are present). Midfemur all dark except for a line of pale scales on the basal half of the posterior aspect. *Genitalia* (Figs. 5 and 9): Inner dorsal surface of basistyle covered with short, stiff, curved setae, those near the apex being considerably longer than the others; basally the dorsal inner surface bears a sparse clump of very long setiform scales; the sclerotized ridge along the dorsal inner basal margin with 6–9 stout setae. Dististyle appendage 0.56–0.66 (4 specimens) as long as the dististyle. Blade of claspette only slightly enlarged medially, uniform in texture. Ninth tergite with 3–4 stout setae on each lobe.

Female.—Wing: 2.75 mm. Differs from the female of *lacteus* as follows: Palpus approximately one-fifth to one-sixth as long as the proboscis. Scutum with the anterior two-thirds solidly white scaled, the white scaling extending along the lateral margin to a level with the prealar area, no white scales around the prescutellar bare space. Midfemur dark, a line of ventrobasal pale scales on posterior aspect, these may extend onto ventral aspect. Abdominal tergites from V on with complete dorsal bands.

Larva (10 larval skins, associated with adults, from Palawan and Luzón).—*Head:* Antenna with hair tuft inserted just before middle, 7–13-branched; one subterminal bristle from one-third to one-half the length of the other. Median mouth-brush hairs with prominent comblike tips (visible in only one specimen). Preclypeal spines distinctly slenderer than in the other species described here. Head hair 4 with 7–11 branches, 5 with 6–12, 6 with 6–10, 7 with 8–14, 8 with 1–3, 9 with 3–5, 12 with 10–15. Mentum with 8–10 lateral teeth. *Abdomen* (Fig. 16): Prominent stellate tufts present. Dorsolateral hair of I with 4–7 branches, the lateral hair with 1–2; lateral hair of II with 3–6; lateral hairs of III–VI with 2, rarely single. Pentad hair 1 with 5–7 branches, 3 with 5–7, 5 with 4–8. Comb teeth 12–16 in number, with prominent lateral fringe to just before apex. Siphon smooth; dark, except for apical portion; index approximately 2; acus detached; hair tuft 6–11-branched; 17–23 dark pecten teeth, basal teeth the smallest, each tooth pale apically, a stout lateral denticle, one or more minute spines usually present on basal portion; length of apicodorsal hair more than one-half the width of the siphon apex. Anal plate with a group of prominent laterocaudal spines, lateral hair 1–3 branched (usually double), *isc* 7–9-branched. Ventral brush with 10 tufts, each tuft with 5–12 branches. Anal gills broadly lanceolate, dorsal pair 1.1–1.3 times longer than the ventral pair and 0.55–1.0 as long as the length of the anal plate.

Brug (1939)[9] states that the larva of *niveus* (Netherlands Indies) does not have the acus detached. Otherwise, the Philippine material checks well with his description. The larva occurs commonly in tree holes (frequently in mangrove areas) and bamboo stumps. One record from deep sheltered rock holes exists.

Taxonomic discussion.—Ludlow sent a specimen of this species to Theobald and allowed him to quote her description (Mon. Cul. 3: 139. 1903). This specimen was designated as type (lectotype) byBarraud (1934). A series of three females bearing red type labels (Type No. 27792) exist in the U. S. National Museum. Although the lectotype has not been seen for comparison, these are considered lectoparatypes on Ludlow's inclusion of them in the original type series.

It is unfortunate that the first association of

[9] Brug, S. L., Tijdschr. Ent. 82: 106. 1939.

a male and larva with this species was done from material collected far from the type locality. However, recent associated larval-adult collections made by the author and others in the Philippines have disclosed that a common member of the *niveus* subgroup found there has a male and larva as described by Brug and a female that fits Ludlow's description; so it seems apparent that Brug's association is correct.

Ludlow's specimens have the black area of the hind femur confined to slightly less than the apical one-fifth of the anterior aspect, although on the dorsal aspect the black scaling is more extensive. In this character, her specimens show a slight variation from the material used for the above description, in which the black of the anterior aspect is usually as extensive as that on the dorsal aspect and is one-fourth or more of the femur. Ludlow states that the female tarsal claws are simple but an examination of a mid leg of one of her specimens showed that the claws are toothed.

Distribution.—Because of the number of closely related species, literature records of *niveus* must be considered with caution, unless careful descriptions are appended. Feng's[10] description of *niveus* is an example of this.

Specimens were examined in the U. S. National Museum from the following areas: Palawan: Puerto Princesa, Irahuan River, Tacburos (J. L. Laffoon and D. R. Johnson). Samar: Oras. Luzón: Batangas (H. Hoogstraal), Subic Bay (L. E. Rozeboom). Apparently reliable literature records are from: South Bengal, Ceylon, Andaman Islands, Sumatra, Bali, Java, Flores, Malacca, Borneo, and Siam. The records from China and Japan are probably not this species. Of the Philippine records given by Bohart (*A synopsis of the Philippine mosquitoes*, NavMed. 580. 1945): only that for Oras is definitely this species.

Aedes (Finlaya) albolateralis (Theobald)

1908. *Stegomyia albolateralis* Theobald, Rec. Ind. Mus. **2**: 289. (Female.) (Type locality: Sylhet, Assam. Type: females, in Indian Mus.)
1908. *Stegomyia nivea* Ludlow. Leicester, The Culicidae of Malaya: 87. (Description implies a misidentification.)
1922. *Aedes* (*Finlaya*) *albolaterlis*, Theobald. Edwards, Indian Journ. Med. Res. **10**(2): 465. (Misspelling.)
1923. *Finlaya nivea* (Ludlow). Barraud, Indian Journ. Med. Res. **11**(2): 480. (In part. Figure of male genitalia.)
1931. *A.* (*F.*) *niveus* var. A. Brug, Arch. Hydrobiol. Supp. Bd. **9**: 25. (First separation by male genitalia.)
1932. *A.* (*F.*) *niveus* Ludlow. Edwards, Genera insectorum, fasc. **194**: 154. (In part. Questioned synonymy of *albolateralis*.)

A damaged male of this species from Doom Dooma, Assam (D. E. Hardy), was available in the U. S. National Museum. It agrees with Barraud's (1934)[11] description except that the mid femur is largely dark (a small basal ventral line of pale scales is present on the posterior aspect). Barraud does not show complete setal details of the inner dorsal surface of the basistyle so that a figure has been prepared for this paper (Fig. 6). Also, he shows the texture of the blade of the claspette undifferentiated, whereas in the specimen examined here the enlarged portion of the blade is clear (Fig. 8).

A single unassociated larva (collected from a tree hole on Culion Island, Philippines, Jean L. Laffoon) was taken that checks well with Barraud's (1934)[11] description of this species. It differs slightly as follows: Antennal hair tuft 7–8-branched. Head hair 4 with 13–14 branches, 7 with 9. Mentum with 8 lateral teeth. Dorsal anal gills 1.6 times as long as the anal plate and about 1.2 times as long as the ventral pair.

Distribution.—There are apparently reliable literature records of this species from: Assam, North Bengal, western Himalayas, north Kanara, and Malaya. The records from Japan are doubtful.

Aedes (Finlaya) novoniveus Barraud

1934. *Aedes novoniveus* Barraud, Fauna of British India, Diptera, **5**: 211. (Males and females.) (Type locality: Mungpoo, Darjeeling Dist., eastern Himalayas. Type: Male, in Brit. Mus.)

Male.—Wing: 2.5 mm. Resembling the description of *saperoi* but differing as follows: Vertex covered with white scales, forked uprights brownish yellow. Scutum completely covered with white scales except on the prescutellar space, which is bare. Scutellum with broad white scales. Forefemur as in *saperoi* but with the posterior pale area only extending

[10] Feng, L., *loc. cit.*

[11] *Fauna of British India, Diptera*, **5**: 205.

slightly beyond middle, and reaching the dorsal margin along most of its length; midfemur dark, a patch of white scales basally on the ventral aspect, posterior aspect white basally, the white extending apically along ventral margin; hind femur white, apical one-fourth completely dark. *Genitalia:* Basistyle with inner dorsal surface covered with slightly curved short stiff setae; basally the dorsal inner surface bears a sparse clump of long setae; the sclerotized ridge on the dorsal inner basal portion of the basistyle not visible in the specimen available but figured by Barraud as carrying a row of about 8 setae. Dististyle appendage 0.5 as long as the dististyle. Blade of claspette distinctly widened medially, the enlarged portion of a clear texture. Ninth tergite with 4 stout setae on each lobe.

Taxonomic discussion.—Neither female nor larval specimens of this species were available. The specimen (U.S.N.M.) used for the above description of the male is from the Cameron's Highland, Federated Malay States, and was reared from bamboo. It was identified (without use of genitalia) by Edwards in 1923 as *niveus*.

Distribution.—Eastern Himalayas, Assam, and Malaya.

Aedes (Finlaya) idjenensis Brug

1934. *Aedes* (*Finlaya*) *niveus* var. *idjenensis* Brug, Bull. Ent. Res. **25**: 513. (Sex not stated, but female by inference.) (Type locality: Eastern part of the Malay Archipelago. Location of type not recorded.)

This form is specifically distinct on the possession of a patch of flat broad scales on the posterior part of *ppn.* Feng's[12] *niveus* is apparently a closely related species.

Aedes (Finlaya) niveus subgroup, unidentified species

Four females, which were reared from a tree hole at Zamboanga, Mindanao (Jean L. Laffoon), appear to be yet another species of the *niveus* subgroup. However, in the absence of males, the species is not named here.

In the key to adults these specimens key to *niveus* and the other species grouped there. They differ from *niveus* (at least Philippine specimens) in possessing white scales along the prescutellar space and in having a prominent median ventral band of silver scales on the anterior aspect of the midfemur. In connection with this last character, it is not completely clear from the description of *pseudoniveus* (Edwards, in Barraud's Fauna of British India, Diptera, **5**: 105. 1934) just what the median silver spot of the midfemur is like in that species. Therefore, it is possible that this species should go to *pseudoniveus* in the adult key.

The larvae (3 isolated skins) go to *alboniveus* in the key given in this paper. Unfortunately, Barraud's (1934)[13] description of the larva of *alboniveus* is too fragmentary for complete comparison. Because of this fact, a brief description of the Mindanao larva is given here. Antennal hair tuft 9–14-branched; subterminal bristles distinctly unequal. Head hair 4 with 15–19 branches, 5 with 8–14 ,6 with 10–12, 7 with 12–14, 8 with 2–3, 9 with 6–9. Mentum with 9–10 lateral teeth. Lateral hairs of abdominal segments I–VI double. Comb teeth 8–10 in number, fringed on basal portion of shaft. Siphon index approximately 3.4; acus detached; hair tuft about 4-branched; 14–16 pecten teeth, a stout lateral denticle present, 1 or more minute spines present basally; length of apicodorsal hair less than one-half the width of the siphon apex. Lateral hair of anal plate double. Ventral brush with 8 tufts, each tuft 3–4-branched. Anal gills extremely elongate, slender, dorsal pair 1.2 times longer than the ventral pair and 3.4 times as long as the anal plate.

[12] Feng, L., *loc. cit.*

[13] *Fauna of British India, Diptera,* **5**: 210.

ZOOLOGY.—*A remarkable new genus and species of West American marine mollusks.*[1] PAUL BARTSCH, U. S. National Museum.

Some time ago the U. S. National Museum received a lot of a very remarkable minute marine mollusk transmitted to us for identification by Mrs. Carrie L. Simons. An examination of the radula proves this to be rhipidoglossate, while the operculum is thin, corneous, and multispiral. I believe the genus to be a member of the superfamily Trochaceae, with the genotype *Coronadoa simonsae*, n. sp., here described.

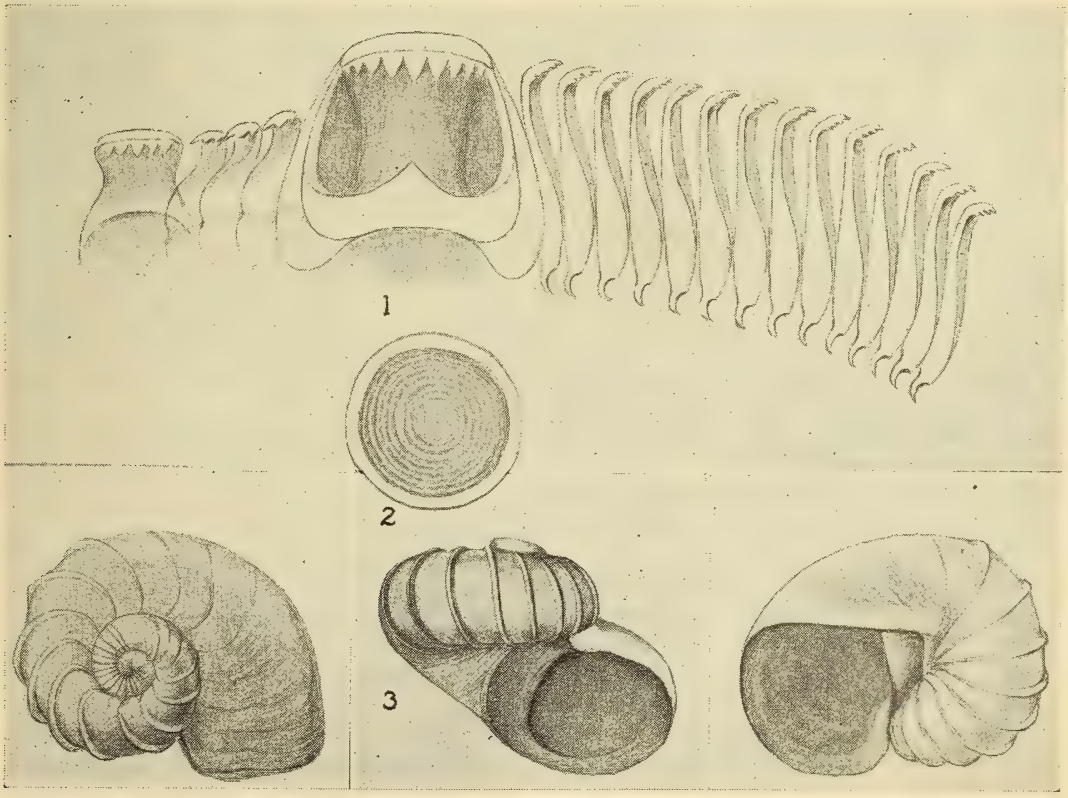
Coronadoa simonsae, n. gen. and sp.

Shell minute, helicoid, thin and translucent, yellowish white, the nucleus consisting of one well-rounded smooth turn. Postnuclear whorls strongly rounded, provided with scalariform ridges, which extend from the summit to the umbilical area; these ridges are a little more closely crowded on the first postnuclear turn than on the succeeding, becoming evanescent on the last half of the last whorl. Periphery of the last whorl rounded. Base well rounded, with an impressed umbilical chink. Aperture very large, subcircular; outer lip rather thin; inner lip very broad, showing a decided excavation; operculum thin, multispiral. The radula has a 5-cusped rachidian tooth followed by three tricuspid laterals and a 9-cusped major lateral, which is succeeded by 14 4-cusped marginals. The shape of these teeth is shown in Fig. 1.

This little mollusk was discovered by Mrs. Carrie L. Simons, for whom the species is named. The greater diameter of the type, U.S.N.M. No. 346654, an average specimen, is 0.6 mm and the altitude about 0.5 mm.

Of the finding of these specimens Mrs. Simons says that they were collected by Frank

[1] Published by permission of the Secretary of the Smithsonian Institution. Received March 25, 1946.



FIGS. 1–3, *Coronadoa simonsae*, n. gen. and sp.: 1, radula; 2, operculum; 3, shell.

Stephens, of the San Diego Society of Natural History, on North Coronado Island, which is almost inaccessible, rising precipitously from the deep water with no beach, so that landing here is effected with great hazard. Mr. Stephens brought a small quantity of sand, really crushed rock, which he found under one rock at the water's edge in April 1921.

U.S.N.M. No. 346655 contains a lot of additional specimens, while the major portion is in Mrs. Simons's collection. Mrs. Simons estimates that there are about 250 specimens of this species in the sending she transmitted. Mrs. Simons's collection is now in Stanford University.

BOTANY.—*A second species of* Hackelochloa.[1] Ruth Chen-Ying Chou, U. S. National Museum. (Communicated by Agnes Chase.)

During the identification of grasses from Burma collected by R. O. Belcher and M. L. Steinecker my attention was called to *Hackelochloa.* This genus, since its establishment by Otto Kuntze (1891), has remained monotypic, containing the single species *Hackelochloa granularis* (L.) Kuntze. In the Burmese collection a second species of the genus was found. Comparing the specimen with the type collections in the U. S. National Herbarium, this was found to be identical with Hackel's *Manisuris porifera,* which up to date has not been transferred to the genus *Hackelochloa.*

The establishment of the genus *Hackelochloa* in honor of Professor Hackel and the description of *Manisuris porifera* by Hackel occurred in the same year (1891), if not simultaneously. Not realizing the differences between the generic concept of Hackel and of Kuntze, one may wonder why the two botanists, who were evidently in touch with each other's work, could have failed to transfer *Manisuris porifera* to *Hackelochloa.* Hackel was a strict "conservative" taxonomist. His concept of genera was very broad. He refused to accept Kuntze's *Hackelochloa* in spite of the honor, including it in *Manisuris.*

Manisuris porifera Hack. was published with a brief description and comparison with *Manisuris granularis.* This generally inaccessible description is quoted below together with a more detailed description drawn from specimens from Burma, Tonkin, and Sumatra in the U. S. National Herbarium.

[1] Received June 24, 1946.

Hackelochloa porifera (Hackel), nov. comb.

Manisuris porifera Hackel, Oesterr. Bot. Zeitschr. **41**: 48. 1891.

"Spiculis ♂ depresso-semiglobosis, gluma I. basi utrinque poro rotundo ab articulo distincta, grosse foveolata et tribus rugis elevatis transversis pluribusque longitudinalibus brevibus notata.

"Culmi, folia, inflorescentia ut in *M. granulari.* Spicae ca. 3 cm longae; spiculae 2.5 mm longae, non globosae, sed depresso-semiglobosae, brunnescentes, callo 1 mm longo subquadrato foveolato in reliquam glumam sensim abiens. Gluma I. basi utrinque ita excisa, ut inter se aximque pori rotundi relinquantur, dorsa rugis v. costis valde elevatis subreticulatis inter se foveolas profundas relinquentibus notata. Reliquae glumae ut in *M. granulari.* Spiculae pedicellatae (pedicello adnato neutrae) 3 mm longae, oblongae, fusco-rufescentes; gluma prima 5nervis, II. 3nervis, reliquae θ [wanting].

"Sikkim: Dikeeling ad 3000′. C. B. Clarke nr. 975."

Plants annual; culms up to 1.5 or 2 m tall, rooting at the basal nodes, much branched above; sheaths much shorter than the internodes, 3 to 5 cm long (about one-fifth to one-half as long as the internodes), papillose-hispid, hairs straight, erect or spreading; ligules fimbriate-membranous; blades flat, up to 20 cm long, 1 to 2 cm broad, base subcordate, both surfaces hirsute.

Racemes solitary, terminating the culm and branches, 2 to 4 cm long, 1 to 1.5 (rarely 2) mm broad; peduncle somewhat clavate below the raceme; spikelets in pairs along the rachis, the fertile sessile, the sterile pedicellate, the

pedicel and rachis-joint adnate; fertile spikelets obovate, dorsally compressed, the margins inflexed, about 2 mm long, 1.5 mm wide, more or less vertically arranged on the rachis, thus appearing as a single vertical row; first glume coriaceous, with sharply raised angular ridges surrounding thin round spaces, thus appearing porous or pitted, closely appressed to the rachis, covering the entire floret; second glume adnate to the rachis, small, pale, covered by the first glume; glumes of the sterile spikelets chartaceous, often purplish (in dried specimens); lemma and palea obsolete.

Hackelochloa granularis, the type of the genus, is found in tropical and subtropical countries of both hemispheres. In the U. S. National Herbarium there are specimens from India, Ceylon, South China, Formosa, Philippine Islands, East Indies, Australia; and eastward to the Hawaiian Islands, United States, Central America, West Indies, and South America. *H. porifera*, so far as known, is limited to the eastern hemisphere—India, Burma, Tonkin, and Sumatra.

Hackelochloa porifera is slightly taller and somewhat more robust than *H. granularis*. In *H. granularis*, the sheaths rarely exceed 3 cm long, whereas those of *H. porifera* often range from 3 to 5 cm. However, the variation in size and general habit of the plants may be influenced by environmental and physiological conditions and therefore are unreliable to serve as a criterion for specific distinction. The two species are best differentiated on the size, shape, and the arrangement of the spikelets. In *H. granularis* the spikelets are globose or subglobose, seldom exceeding 1 mm in diameter, and more obliquely arranged on the rachis, each raceme therefore bearing two distinct rows of alternate fertile spikelets with the glumes of the sterile spikelets above. The first glume of the fertile spikelets in *H. granularis* is verruculose, finely reticulate or granulate with margins inrolled downward like a pouch. The fertile spikelets in *H. porifera*, on the contrary, are oval, half as broad as long, almost vertically arranged on the rachis with the tip of one spikelet pointing nearly directly at the base of the next one of the alternate row, the two rows of fertile spikelets thus appearing as a single one. The first glume of the fertile spikelet is strongly reticulated with prominent ridges and pitted thin spots, with margins sharply bent inward and ridged at the edge like turtle shell, and closely appressed to the rachis. The sterile spikelets, composed of glumes only, are lateral in position.

Type specimen.—C. B. Clarke no. 975 in Herb. Hackel, from Sikkim, India; fragment in U. S. National Herbarium.

Other specimens studied.—Burma: Mytkyima-Sumprabum Road, on open roadside, clay bank, *Belcher & Steinecker 819*, October 16, 1945. Tonkin: *Balansa 4940*, September 21, 1891. Sumatra: east coast, Vale of Tangga, Asaham, steep jungle path to Adian Langge, *Bartlett 8085*, May 12–21, 1927; vicinity of Rantau Parapat, Bila, *Rhamat Si Toroes 1731, 1788*, March 28–May 10, 1932; Tapianoeli Division Padang Si Dimpoean, Subdivision Padang Lawas, along the Aek Roppak, near Hoeta Imbaroe, *Rahmat Si Toroes 4742*, June 22–30, 1933.

Obituary

Thomas Barbour, director of the Museum of Comparative Zoology of Harvard College, died in Boston, Mass., on January 8, 1946, the immediate cause of his death being a cerebral hemorrhage. Son of wealthy parents, he was born on Marthas Vineyard Island on August 19, 1884, and was graduated from Harvard University in 1906, returning to that institution for the master's degree (1909) and for the Ph.D. degree (1911). Before completing his studies he made extensive collecting trips to the West Indies, Chile, Mexico, India, and Malaysia, and this field work was continued, at intervals, in various parts of the world, throughout his later life.

At an early age Barbour elected to follow zoology as a profession. In fact, the reason for his selecting Harvard University as the institution for his undergraduate and graduate training was the unique zoological facilities offered by the museum that Louis Agassiz founded and that later became an integral part of Harvard University; and when Dr. Barbour appointed as director of the Museum in 1927, he was fourth in succession from Louis Agassiz. In 1928 he was appointed as professor of

zoology, and in 1944 as Alexander Agassiz professor of zoology. From the time that he received his Ph.D. degree in 1911, when he was appointed to an assistant curatorship in the Museum, to his untimely death in 1946 (for he had not attained his sixty-second birthday), he was constantly associated with the Museum of Comparative Zoology, serving as a volunteer servant of Harvard University, with only a token salary, for zoological research was his abiding interest; and the extraordinary zoological facilities that were available to him at Harvard were exploited to great advantage during the ensuing busy years.

He was fortunately in a position where he could be of great service. From his ample private income he granted distinctly large sums to support work in which he was interested, not only to the Harvard Museum of Comparative Zoology, but to other institutions as well, including the Barro Colorado Island Station in Panama, which to a considerable degree owes its existence to Dr. Barbour's continued support, the Atkins Institution of the Arnold Arboretum in Cuba, and the New England Museum of Natural History. In relation to those institutions and projects in which he had confidence he was not only liberal within his means, but, what is better, intelligently liberal.

A prolific writer on an extraordinarily wide range of subjects in zoology, Dr. Barbour's technical titles number nearly 400. In his own words, he was "by inclination an old-fashioned naturalist, many tell me the last of the breed. My colleagues prefer to know more and more about less and less, and so are infinitely more erudite than I." He was a world authority on the classification of reptiles and amphibians, but he wrote with authority also on such diverse subjects as ornithology, mammology, conchology, ichthyology, entomology, and paleontology. Outside of his strictly zoological interests his services were in demand in other quarters, for, among other distinctions, he served as president of the New England Museum of Natural History, a trustee of Radcliffe College and of the Carnegie Institution of Washington, a member of the Advisory Board of the Guggenheim Foundation, a member of the Council of the Harvard University Library, and a syndic of the Harvard University Press.

Because of his retentive memory, wide interests, command of the English language, and his human attributes, in his later years he developed an extraordinary talent for preparing popular publications. The narrow specialist seldom or never attains such a position. Beginning with his *Naturalist at large* (1943), which is in part autobiographical, and closing with the posthumous *A naturalist's scrapbook* (1946), he succeeded in popularizing certain aspects of his zoological interests in a most striking manner; in fact, the picture he painted of what man has done to nature in Florida within the present century in his *That vanishing Eden* (1944) is actually having a profound effect on the manifestly much-needed conservation program in that State, as to its water, land, and biological resources.

In the course of his productive career, Dr. Barbour was the recipient of many distinguished honors, having been elected to membership in such domestic and foreign societies as the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Royal Asiatic Society, the Royal Geographic Society, the Linnean Society of London, the Zoological Society of London, the Nederlandsche Dierkundige Vereen, and the Havana Academy of Sciences. In the academic field he was the recipient of the S.D. degree from the University of Havana (1930), from Dartmouth College (1933), from Harvard University (1940), and from the University of Florida (1944).

Dr. Barbour was a commanding figure in any gathering, for he was 6 feet 5 inches tall and proportionately stout, weighing in excess of 300 pounds. He did not hesitate to express his ideas, and this he could do in a very trenchant manner. His judgment was excellent and his conclusions usually well taken. His sense of humor was very keen, and many Barbourisms will doubtless persist for a long time to come. His very numerous friends at Harvard University and elsewhere will long keep his memory green. His lasting position as an outstanding zoologist is assured.

He was the son of William and Adelaide (Sprague) Barbour of New York City. He is survived by his wife, Rosamond Pierce Barbour of Boston, three daughters, Mrs. Mary Bigelow Kidder, Miss Julia Adelaide Barbour, and Mrs. Louisa Bowditch Parker, and two brothers, Robert Barbour and Frederick K. Barbour.

ELMER D. MERRILL

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PHYSICS.—*On understanding electric breakdown in solids.*[1] R. J. SEEGER, The George Washington University.

The seventeenth century marks the beginning of the modern study of electricity and magnetism. In the year 1600 William Gilbert of Colchester published his monumental work *De magnete, magneticisque corporibus, et de magno magnete tellure.* In this book he mentioned 20 materials, such as glass, which behave like amber in that when they are rubbed they have the power of attracting light objects. The Greek word for amber being *electron* (ἤλεκτρον), he designated these materials by the word electric, i.e., like amber (it is only later that such bodies were believed to be charged or loaded with a quasi-fluid electricity). He remarked further that certain other substances, notably metals, do not have this characteristic feature. They, therefore, may be regarded as being nonelectric.

More than a century later Stephen Gray pointed out that this distinction between electric and nonelectric substances is not fundamental but rather accidental in that it depends to a great degree upon another physical property, namely, conduction. For example, if a piece of glass is brought temporarily into contact with an electrified body (one that has been made electric), upon separation the glass itself will not be electrified. On the other hand, if a metal is brought temporarily into contact with an electrified body (with proper precautions), it will be found to be electrified upon removal. In the latter case there has been a transfer of some of the electrification by contact—a process known as conduction. It is this very property, indeed, that causes the electrification of a metal to be commonly unnoticed when the metal is held in one's hand and rubbed. In this instance the electrification is immediately shared with the much larger earth by way of the person's body. If precaution is taken to prevent such a transfer, a metal or any other substance can be made electric by being rubbed. What Gilbert called electrics are essentially nonconductors; so-called nonelectrics are in reality conductors.

Nowadays it is customary to differentiate conductors and nonconductors (more commonly called insulators) in terms of their ability to carry an electric current. Thus if a conductor connects a source of positive electrification (the state of polished glass when rubbed with silk) with a source of negative electrification (the state of hard rubber when rubbed with fur), it is said to carry an electric current, which is manifested in thermal, magnetic, and chemical effects (under certain conditions). No matter how weak the electrification (measured by its so-called voltage), there will always be an electric current—correspondingly weak, of course. On the other hand, if an insulator such as table salt (or any other alkali halide) is made to connect the same sources of electrification, it will be found to carry no electric current. Even though the voltage is considerably increased, an electric current is barely detectable. Only when the voltage across each centimeter of material is about 100,000 volts is there a significant current, which slowly increases with still further voltage increments.

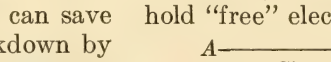
[1] Address of the retiring president of the Philosophical Society of Washington, delivered at the 1226th meeting of the Society, January 15, 1944, when the author was on War Leave with the Bureau of Ordnance, Navy Department. Received April 26, 1946.

SEP 23 '46

In the neighborhood of 500,000 to 3,000,000 volts per centimeter, however, the electric current suddenly becomes appreciable. The insulator then behaves like a conductor. The understanding of this phenomenon of electric breakdown is the purpose of our brief survey this evening.

First of all, however, a digression may be permissible in order to clarify our terms. What do we mean by the phrase understanding a phenomenon? In this regard there is an interesting expression used by Plutarch to characterize the spirit of early Greek astronomy. The mathematical astronomer Aristarchos of Samos is described by him as seeking "to save the phenomena" of the heavens. For the nightly pageant of the sky seems even now to be readily understandable in terms of circular motions of the sun, the moon, and the stars about the earth, but on the face of it there is one disturbing anomaly—the irregular behavior of the planets. These wanderers, as their name signifies, move apparently in loops. The essential need, therefore, is to save face, to make the idea of celestial circular motion safe despite the appearances, or—to use the Greek word for appearances—to save the phenomena (*σώζειν τὰ φαινόμενα*). Now how is it possible thus to save a phenomenon? By getting a proper point of view—usually a wider one from a higher level—that will merge both the regular appearances and the irregular appearances into a single scene! In this connection one is reminded of a spectator seeking a high seat to focus his attention on the stage of a Greek amphitheater. Indeed, it is noteworthy that the etymological root of the word *theater* is the same as that of the word *theory*, namely a view. When we are theorizing, we are simply trying to get a proper point of view. Thus we can save the phenomenon of electric breakdown by arranging a more inclusive theory which will enable us to view wholly the regularities of conductors and of insulators together with the apparent irregularity of electric breakdown. Our problem can be formulated briefly as follows: how is it theoretically possible for an insulator to become a conductor? In order to answer this question, however, we need to review theoretically two other questions: What is a conductor? What is an insulator?

We begin by noting that most of the chemical elements are metals, and consequently conductors. Hence we may profitably examine a metal as a typical conductor. Now almost any textbook of general physics makes the differentiation that metallic conductors contain electrons (minute masses with negative electrification) that are free to move, whereas insulators do not, so that an electric current is equivalent to a continuous electronic shift in an electric field of force. Leaving aside for the moment the precise validity of this distinction, we pursue the clue that the macrocosmic property of conduction may be explicable in terms of these universal elementary particles. Incidentally, it is generally recognized, of course, that ascertaining the attributes of such elementary particles is properly the domain of physics, but it is less emphasized that the theoretical interpretation of the properties of ordinary matter in terms of these very same particles is an equally important physical problem (less glamorous, but not less significant). That such electrons may be inside a metal is an experimental inference from the fact that the jarring of a metal by heat, by ultraviolet light, or by X-rays may result in the emission of electrons. Moreover, it is reasonable to regard these electrons as the loosely held ones on the outside of the metallic atoms—the very valence electrons that take part in chemical combinations—which may even be considered as shared freely by all the atoms. Thus for our immediate purpose we may picture a metal as virtually a box, somewhat like an ordinary box which can hold things, nevertheless a particular kind of box which can hold "free" electrons.



Simple model of a metal

Let us examine more closely our crude model of a metal as a box. For simplicity of argument we shall consider a one-dimensional box, represented by the straight line AZ in the accompanying figure. By definition, then, within AZ free electrons are found; outside AZ there are none. Now physically what do we mean when we say

there are free electrons inside a metal box? To answer this we must bear in mind our modern concept of an electron as an elementary particle characterized fundamentally by its electric charge, its mass, and its so-called spin, and existing momentarily in a certain state of energy. Because of Heisenberg's uncertainty principle, of course, any precise specification of the energy state of an electron precludes the possibility of locating it exactly. All we can say *a priori* is that an electron may be here, there, or elsewhere in a given region (AZ). To predict specifically which place is more or less likely we need to know the function that satisfies a certain partial differential equation (Schrödinger's), which happens to be analogous to that of a vibrating string. The solutions of this equation have a wavelike character, and these so-called wave functions describing the state of an electron in the box are characterized by a set of parameters (quantum numbers) which are determined by the boundary conditions (at A and at Z). Each state of motion can be regarded as similar to that of a finite, uniform string with fixed ends; namely, a definite nodal pattern with varying amplitudes of vibration. The most remarkable feature of such motion is this restriction of allowable patterns, viz., that only certain wave functions with particular energy values are possible, in other words, only certain frequencies of vibration; in short, a discrete spectrum of wavelengths. Hence an electron in such a box may have any one of a group of energy values, called energy levels if ordered (usually so close together that they are said to be quasi-continuous), and may be any place in the box (the probability of a given position depends on the square of the wave function). Because of Pauli's exclusion principle, however, no more than one electron in a system can be regarded as being associated with the same wave function, although it so happens in this case of an electron gas that for each energy value there are actually two wave functions (said to be a state of spin degeneracy). Thus only two electrons may be regarded as having the same lowest energy value (in this instance not zero); two other electrons may be looked upon as occupying the next higher energy level; two others the next higher one; etc. Hence even at a temperature of absolute zero there are electrons that have energy about 100 times the average energy of a molecule of a gas under normal conditions of temperature and of pressure. Strange as this fact may seem in itself, it is less significant than one of its consequences, namely, that only the electrons with the highest energy values can have their energy increased by small amounts, inasmuch as such increments are not sufficient to raise electrons from the lower occupied levels to the vacant levels, which all have high energy values. It is for this very reason that comparatively few electrons share in the distribution of thermal energy and that, consequently, the electronic contribution to the specific heat of a metal at room temperature is small in comparison with that of the atomic residues.

For ordinary electric fields of force (measured by the voltage per centimeter), too, the possible increments of energy are so small that only those electrons in the higher energy levels are involved in the process of conduction. Upon collisions of these high-speed electrons with the atomic residues of the metal lattice the newly acquired kinetic energy of the electrons is transformed into random vibrational energy of the lattice, i.e., into thermal energy—a process which is commonly characterized as electrical resistance. The mean free path between collisions of these so-called conduction electrons with the atomic residues at room temperature turns out to be not the interatomic distance, but rather a distance 100 times greater. Of course, at absolute zero the mean free path would be infinite (cf. the electrical resistance of a pure metal is approximately proportional to its absolute temperature so that it would seem to extrapolate to zero at absolute zero—in other words, a metal would become a perfect conductor). These facts appear paradoxical until it is recalled that at absolute zero the atomic residues form a perfectly regular array; the resulting lattice is effectively a grating with its grating space several times smaller than the wavelength of the fastest electrons so that their

passage is practically undisturbed. To use a different analogy, the conduction electrons behave like a perfect fluid which adjusts its irrotational flow to conform to all the boundaries.

We now have a preview of electrical conduction, i.e., a theory based upon a simple model. Under normal conditions there are just as many electrons moving in any given direction in a metal as in the opposite direction; hence the net quantity of electricity passing through any plane is zero. Upon application of a field, however, those electrons having the highest energy values continuously acquire additional speed in the direction of the field, and in turn, continually lose these gains of kinetic energy upon collision with the atomic residues. Thus the original dynamic equilibrium is unbalanced and a net quantity of positive electricity is transferred in the direction of the field—this virtual electronic shift constitutes the electric current. The essential feature of this view is that comparatively few electrons are involved, whereas for the classical picture all the so-called free electrons were regarded as participating equally in the transfer of electric charge. In one respect, of course, the net result is the same; for the transfer of any quantity of electricity depends upon three factors, namely, the magnitude of each elementary charge, their number, and their speed. Although there are fewer electrons involved in the new picture, they are all moving so much faster that the electric current is approximately the same.

This heuristic picture of the process of electrical conduction does not contain an adequate concept of a conductor, perhaps, because the latter must be intimately linked up with the concept of an insulator. Accordingly we reconsider the usual differentiation of these two physical objects in terms of free electrons. Now in what sense are the valence electrons in our box-like conductor free? On the one hand, of course, they are completely free—free to move anywhere in the box. On the other hand, only the few conduction electrons are free—free to gain energy continuously from an applied electric field. The following analogy summarizes our concept of free electrons in a conductor. A valence electron in a conductor is as free as an actor who belongs to a certain company and who is privileged to play any role of the cast provided it is not being played by another member. Now then what about similar electrons in insulators?

As soon as we glance at a table of electrical conductivities (the measure of the amount of electric current conducted by a particularly shaped material of unit volume in a field of unit strength), we observe that some important factor must have been neglected in our simplified theory. For from our present viewpoint of the preferred position of the high-energy electrons we might be led to suppose that all metals would have the same electrical conductivity, whereas we intuitively feel that a metal should be a better conductor the more valence electrons it has. The experimental data do reveal valence dependence, but of the opposite tendency. For example, univalent sodium is a better conductor than divalent beryllium, which, in turn, is a better conductor than trivalent gallium. What we have overlooked is the attractive effect of the increase of the unbalanced positive charges on the atomic residues as the number of valence electrons increases. The atomic lattice evidently cannot be neglected!

For each individual atom itself may be considered effectively a small box that holds comparatively few electrons. Consequently it, too, has a certain discrete set of energy values, which may be regarded as associated with specific electronic orbits. Now if two such atoms are a great distance apart, the cloud of revolving electrons surrounding one nucleus shields its effect on the electrons about the other nucleus. On the contrary, if the outer electronic orbits of the two atoms overlap, the outer electrons of one atom are now influenced by the attraction of the nucleus of the other atom. In other words, the electric potential (measured by the work required to bring a distant positive unit charge to a point) in the region between the two atoms is lowered and electrons concentrate there (this condition is enhanced by the virtual attraction of two electrons with opposite



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spins). Thus the potential energy of the new configuration is lowered and the state is more stable; hence the atoms remain together as a molecule. Now a metal is merely a collection of such neighboring atoms, essentially a large molecule with atomic residues spaced at regular intervals and influencing the immediate electrons in proportion to the number of valence electrons. Thus our box-like metal may be thought of as containing a large number of smaller boxes arranged so as to give it an internal periodic structure. The motion of the electrons themselves in our one-dimensional model is evidently not so much like that of a uniform string with fixed ends, as we have previously supposed, but more like that of a row of similar beads connected by similar springs and fixed at the ends.

By way of orientation, therefore, let us review the analogous classical problem of a chain having N similar, equally spaced beads with similar springs as links, the end beads being fixed. In this case the possible energies for longitudinal vibrations form a discrete set of N values, but because of the dispersion of the elastic waves they are all confined within a narrow band, for which the highest frequency corresponds to a minimum wavelength equal to twice the minimum distance of separation of the beads. Even though overtones as such do exist, they are associated with the same band of energy values (actually, there is a periodicity in reciprocal wavelengths resulting from the periodicity of the bead spacing). Let us modify our problem so that the chain now consists of N massive beads alternating with N light ones. Then if each neighboring pair is roughly grouped as a single bead, the resulting motion will be similar to that in the preceding problem; there will be N discrete levels, both beads of a pair moving together. In addition, however, another band of higher-energy values exists; it corresponds to the higher-frequency motion in which the massive beads and the light beads move in opposite directions. It may be noted that the lattice vibrations of an alkali-halide crystal, which contains alternately positive and negative ions, are actually analogous to those of this second example. In this case, too, there are two motions of the oppositely charged ions: the acoustical branch with little phase difference and the optical branch with much phase difference. For the latter type of vibration there is a rapidly varying relative displacement of the charges and, consequently, electromagnetic radiation; it is this kind of motion (transverse, however) that is the mechanism of the infrared (so-called "restrahlen") absorption characteristic of the alkali halides.

In general, the vibration patterns for an electron in a solid are much more complex even than those of the above illustrations, but their distinctive feature is essentially the same, viz., distinct bands of discrete energy values with gaps occurring at electron wavelengths for which diffraction occurs. (The condition for diffraction, of course, depends upon the grating space.) Inasmuch as the interatomic distances vary in different directions, it may happen that the bands overlap in certain directions, i.e., a given range of energy values may be forbidden if the electrons travel in one direction, but allowed if they move in other directions.

On the basis of such band structures, we are now able to distinguish theoretically between a conductor and an insulator. We shall have need to bear in mind our previous observation that because of so-called spin degeneracy there can be two electrons (with opposite spins) associated with each energy value. Consider the univalent metal sodium. For N sodium atoms there are N valence electrons. Consequently the N energy levels of the conduction band (corresponding to the $3s$ energy level of a sodium atom) is only half full; the higher-energy levels of this band are vacant (in addition, there is an overlapping of bands). Therefore, the high-energy electrons of the metal can receive the relatively small increments of energy supplied by ordinary electric fields. Hence sodium is a conductor! The alkali-halide sodium chloride, on the other hand, is an insulator. Why? In this case there are $8N$ valence electrons for N molecules. One band (corresponding to the $2s$ atomic level of chlorine) is filled with $2N$ of these electrons and another one (corresponding to the $2p$ atomic levels of

chlorine) is filled with the remaining $6N$ electrons, whereas a third band (corresponding to the $3s$ level of the sodium atom) is entirely empty. Thus there is a gap between the uppermost filled band and the neighboring empty band so that no electrons can receive small increments of energy. On the other hand, consider the bivalent metal beryllium. In line with our argument for sodium we might expect the $2N$ valence electrons here to fill the conduction band and thus to fulfill the condition for an insulator. Beryllium, on the contrary, is a conductor. What happens is that the overlapping of the bands in different directions causes a resultant band that is only partially full, allowing some of the electrons to receive small increments of energy. The vacant energy levels, however, are not so plentiful as in the case of sodium so that fewer electrons are able to participate in the conduction process; hence the electrical conductivity of beryllium is less than that of sodium.

In summarizing the answers to our two review questions we note first that valence electrons are just as free to move throughout an entire insulator as they are throughout a conductor. The essential difference, however, is that in a conductor some of these electrons are free to receive small increments of energy whereas in an insulator none are able to do so. Completing our previous analogy we remark that in an insulator there are just as many roles as actors whereas in a conductor there are more roles than actors.

We return now to our primary question, viz., how is it possible for an insulator to become a conductor. The answer would seem to be straightforward: the increment of energy must be sufficiently great to allow a high-energy electron to jump from its own band, which is full, to the next higher band, which is empty. This presumably could be accomplished by a great increase in temperature—only the solid would melt before that temperature could be attained. It could undoubtedly be made possible also by a very strong electric field—only an insulator actually breaks down for fields smaller than those that would be expected theoretically. Evidently there is some latent mechanism that accounts for electric breakdown.

It is not unreasonable to seek a clue in the phenomenon of electric breakdown of a gas. When the voltage applied across a gas is slightly less than that required to produce breakdown, free electrons are able to gain sufficient energy over several mean free paths to knock out other electrons upon collision with atoms (ionization by collision). Presumably these latter electrons would be able to free still other electrons, etc. Nevertheless, breakdown does not take place. Why? Can there be some continual loss of energy analogous to friction in mechanics? Indeed, there does exist such a process, the so-called excitation of a molecule, in which an electron is removed only to an outer orbit instead of infinitely far away, as in the case of ionization. Such an electron, however, soon returns to its initial orbit either by radiating, or by increasing the kinetic energy of a colliding molecule (so-called collision of the second kind); in either case its excess potential energy is irretrievably lost. This excitation process is initiated neither by very slow electrons, which do not have sufficient energy; nor by very fast electrons, which do not have sufficient time. For some intermediate speed, however, the probability of excitation, and consequently, of the loss of energy, is a maximum. This speed, then, is the one at which breakdown occurs. Any electron having a slightly greater speed will have a net gain of energy, so that it can continuously acquire sufficient energy to produce ionization instead of mere excitation. In this manner other electrons are freed. These, in turn, are accelerated, they ionize other molecules and free more electrons—thus an avalanche soon results! It is tempting to consider this same mechanism of electronic excitation as effective also in a solid—but without success, inasmuch as the lowering of the atomic ionization potential by the atomic residues in a solid causes it to be not appreciably different from the excitation potential.

On the other hand, the excitation of lattice vibrations does afford an analogous frictional mechanism for electrons acci-

dentally present in every insulator. Here, too, very slow electrons have insufficient energy for excitation and fast ones have insufficient time. Only moderately fast electrons have a significant probability of exciting these vibrations. Again we have a maximum space rate of energy loss. It has been suggested by von Hippel (*1*) that the applied electric field required for an equal space rate of energy gain may be taken as the criterion for electric breakdown; for, an electron in a slightly greater field will experience a net gain of energy and thus eventually acquire sufficient energy to produce ionization. Thus other electrons will be freed, accelerated, etc., until an avalanche of such free electrons is formed, i.e., breakdown occurs. Let us examine this process more closely.

Consider the behavior of a low-speed electron as it passes a positively charged atomic residue in a lattice (the ion may be considered effectively free if the time of passage is much less than the period of a lattice vibration). Along the path of motion (assumed to be linear as a first approximation) there is a component of the force of attraction, which first speeds up the electron and then slows it down so that the net effect is null. At right angles to the path, however, the component of the force of attraction acts always in the same direction and thus produces an increment of impulse. The increased kinetic energy given to the atomic residue can be calculated from a knowledge of the force acting and of the time of passage. Now the force we are concerned with in the dielectric medium must not be computed from the so-called static dielectric constant, which includes the influence of the electric polarization due to distortion within an atomic residue, as well as the effect of the relative displacement of the residue as a whole. The dielectric constant for a high-frequency electric field (e.g., light), on the other hand, is due solely to such electronic distortions inasmuch as the more massive ions do not have time to get under way. Evidently the difference between these two effects measures the force responsible for the ionic displacement alone. Using this value, then, we can calculate the increment of energy received by a single ion per unit length of path. What remains to be done is to sum such increments for all ions influenced by the passing electron. Of course, the very distant ions need not be included inasmuch as the time of passage for them is of the same order of magnitude as the time of a lattice vibration so that the ions are no longer approximately free; instead they follow adiabatically the electron motion. The very near ions, too, are omitted in this classical calculation since it becomes invalid when distances are of the order of the wavelength of an electron. (It should be mentioned, however, that the problem can be formulated just as well completely in quantum mechanical terms, but this evaluation, in turn, involves an approximation that also lacks rigorous justification.) Thus the space rate of energy loss can be determined as a function of electronic velocity; its maximum can be ascertained. It is this maximum space rate of energy loss that must be set equal to the applied electric field for a quantitative expression of von Hippel's criterion for electric breakdown.

Calculations have been made in this manner by Teller and myself (*2*) for the alkali halides; the results are in essential agreement with observations. More recently Attwood and Bixby (*3*) have applied our theoretical expression to data for carbon tetrachloride and have found agreement here, too, although the formula was not derived originally for such a substance. It should be noted also that a formula obtained by Fröhlich (*4*) is equally satisfactory. Fröhlich, too, utilizes von Hippel's frictional mechanism, but he introduces a distinctly different breakdown criterion namely, a field in which acceleration is continuously possible for all electrons having energy sufficient for ionization. The distinctive feature of his picture is that it requires very fast electrons for initiating the breakdown process, whereas our theory starts with comparatively slow electrons. As yet, no decisive experiment has been made to test these hypotheses. Still one other criterion should be mentioned. In an informal communication Seitz (*5*) has suggested

that breakdown occurs when an electron can produce a secondary electron over a path length determined by the number of electrons needed to comprise an avalanche. The consequences of this hypothesis are at present only in a qualitative form.

In searching for an answer to the question, how is it possible for an insulator to become a conductor, we have found clues to the phenomenon of electric breakdown. Our understanding, however, must remain only partial until we can account for the dependence of breakdown upon various physical factors such as temperature and trapping.

Buehl and von Hippel (*6*) have found that the electric breakdown for potassium bromide is 25 per cent less at 200° absolute than at 300° absolute. Moreover, the breakdown field increases steadily with increase of temperature up to 50° Centigrade after which it decreases monotonically. Now the frictional mechanism, it is true, yields a temperature dependence in that according to Planck's partition law the vibrational energy is a function of temperature. This theoretical prediction, however, gives a less rapid increase than that observed and allows for no decrease at all. At present, there is no completely satisfactory explanation of the actual variation with temperature; perhaps, because it is closely related to the other important factor, namely, the possibility of capture to the free electrons involved. Let us turn our attention to this so-called phenomenon of trapping.

In alkali-halide crystals there exist various defects in the ionic lattice. For example, there are vacant places owing to the shifting of some ions to interstitial positions and owing to migration of others to the surface. (In either case the vacated regions may be occupied by neighboring ions, thus making ionic conduction possible.) Now a negative-ion vacancy in an electrically balanced lattice is effectively a positive charge; thus it behaves like an empty box that can hold free electrons. Thus associated with such a vacancy are discrete energy levels, which happen to be just below the conduction band. Experimental evidence of trapping of electrons in such vacancies in alkali-halide crystals is found in the existence of ultraviolet absorption peaks, which are related to the raising of electrons from such discrete energy levels to the conduction band. Furthermore, certain varieties of these crystals have characteristic colors, e.g., yellow for sodium chloride, signifying the comparatively small energy change involved in any absorption of visible light so that the existence of so-called F-centers (Farbenzentren, color centers) has been long postulated by Pohl.

Suppose more than half the free electrons having sufficient energy for ionization are captured by such vacancies in a crystal. Then an avalanche can never result; breakdown cannot occur! It is important, therefore, to calculate the probability of capture of an electron by various processes. This problem, however, presents considerable mathematical difficulties. An initial step has been made by Meyer (*7*), who has investigated trapping by a negative-ion vacancy. We shall illustrate his method for a one-dimensional problem.

Consider an electron moving in a straight line under the influence of an applied electric field and a capture center. There are four special cases depending upon the initial direction of motion of the electron relative to the capture center and to the applied field. Let us consider specifically an electron moving away from a capture center in the direction of the applied field. The attracting force of the capture center can be approximated by the field of force of a hydrogen-like ion in a dielectric (this procedure is sufficiently accurate at least for the outer electron orbits). Owing to the lattice vibrations, as we have just seen, there is a "frictional" force, too; it can be shown to be proportional to $(ln\ v^2)/v^2$ (v is the speed). The problem, then, is to determine the minimum distance from the capture center for an electron with a given initial speed to escape to infinity. Inasmuch as numerical integration of the equation of motion is required in each instance, it is more convenient to formulate the problem in terms of a finite path of motion.

Consider that critical point where the

applied field is just balanced by the opposing field of the capture center. If the electron can reach this point with slightly greater than zero speed, it will henceforth be effectively under the influence of the applied field and will accordingly escape to infinity. The problem, therefore, may now be restated as finding the minimum speed an electron must have at any given distance in order for it to arrive at the critical point with zero speed. Unfortunately this procedure, too, involves considerable numerical work, which, in turn, can be reduced by the following computational scheme. Suppose the electron is initially at rest at the critical point. Allow it to move toward the capture center with a reversed frictional force. Its speed at each point can then be calculated. If the direction of motion at any point is now reversed, the electron will just reach the critical point. For slightly higher speed the electron will escape. If the actual speed of an electron at a given point is smaller than this calculated critical value, the electron will not escape. In other words, if an electron is actually closer to the capture center than the point for which its given speed is equal to the critical value, it will remain captured. In this manner the cross-sectional radius of capture for various speeds of an electron has been estimated for the four possible initial conditions relative to the capture center. The calculations have been carried out in the case of sodium chloride for several applied fields of the order of magnitude of those occurring in breakdown.

The effect of trapping in sodium chloride can then be estimated on the basis of the above calculations. It is found that if there are $(10)^{18}$ capture centers per cubic centimeter, less than half of the free electrons will be trapped so that an avalanche will result. On the other hand, if there are three times as many such centers, half of the electrons will be captured before they reach 13 per cent of the velocity needed for ionization so that the breakdown phenomenon cannot occur. Somewhere in between these two values for the number of capture centers the effect of trapping becomes significant. Now alkali-halide crystals usually have only $(10)^{14}$ to $(10)^{15}$ capture centers per cubic centimeter (the number is greater in the case of single crystals). Hence the influence of trapping should become important for alkali-halide crystals only if they are prepared specially so as to have a greater density of capture centers.

Thus our theoretical understanding of the phenomenon of electric breakdown is contingent upon further experimental knowledge of the controlling factors.

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PHYSICS.—*Forces between linear circuits according to O'Rahilly.*[1] FRANK WENNER, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

Forces between linear circuits (that is, coils of insulating wire with currents in them) have beeen investigated from time to time during the past more than 100 years. Of the workers in this field mention may be made of Ampere, Weber, Maxwell, Webster, Peirce, Mason and Weaver, Gray, Curtis, Helmholtz, Page and Adams, and Cullwick. In addition, many others have had something to say on the subject.

These investigations have led to a particular way of looking at the situation, namely: that each element of any one circuit acts directly on each element of the one or more other circuits and that what we observe is the sum of such actions. It is customary therefore to state the effects observed by means of formulae which frequently are presumed to be statements of laws of actions between elements of circuits.

One of such formulae usually arrived at on an analysis of the actions of two closed circuits on each other may be written as follows:

$$d^2F = PI_1I_2(3\cos\phi_1\cos\phi_2 - 2\cos\gamma)ds_1ds_2/r^2. \quad (1)$$

Here P represents the effective permeability of the ambient space (most writers omit a symbol for the permeability and state that the formula applies in a vacuum or in air); I_1 represents the current in one of the circuits; and I_2 represents the current in the other circuit.

Referring to Fig. 1, ds_1 and ds_2 represent elements of the lengths of the two conductors; r represents the distance between ds_1 and ds_2; ϕ_1 represents the angle between r and ds_1; ϕ_2 represents the angle between r and ds_2; γ represents the angle between ds_1 and ds_2. In general ds_1 and ds_2 are not coplanar. Also, d^2F represents the component of the force acting on ds_1 and ds_2 in the direction of the line joining them.

It is to be understood that the symbols d^2F, P, I_1, I_2, ds_1, ds_2, and r represent physical quantities, not merely numbers of units of physical quantities, while ϕ_1, ϕ_2 and γ represent numerics, that is, numbers.

Of other similar formulae those more commonly used are

$$d^2F = PI_1I_2\cos\gamma ds_1ds_2/r^2 \quad (2)$$

and

$$d^2F = PI_1I_2\cos\phi_1\cos\phi_2 ds_1ds_2/r^2. \quad (3)$$

Now O'Rahilly states that the correct formula is[2]

$$\overline{d^2F} = I_1I_2\overline{ds_1}x(\overline{ds_2}x\bar{r})/r^3 \quad (4)$$

where $\overline{d^2F}$ $\overline{ds_1}$ $\overline{ds_2}$ and $\bar{r}$ represent vectors. If formula (4) is written in such a way that we may attribute to the symbols the significances stated above it becomes

$$d^2F = PI_1I_2\sin\phi_1\sin\phi_2 ds_1ds_2/r^2. \quad (5)$$

In case W represents the mutual potential energy of the two circuits and the ambient space it follows from formulae (1), (2), (3), and (5) that

$$d^3W = PI_1I_2(3\cos\phi_1\cos\phi_2 - 2\cos\gamma)ds_1ds_2dr/r^2 \quad (6)$$

$$d^3W = PI_1I_2\cos\gamma ds_1ds_2dr/r^2 \quad (7)$$

$$d^3W = PI_1I_2\cos\phi_1\cos\phi_2 ds_1ds_2dr/r^2 \quad (8)$$

$$d^3W = PI_1I_2\sin\phi_1\sin\phi_2 ds_1ds_2dr/r^2. \quad (9)$$

Now let it be assumed that ds_1 or ds_2 is moved, without rotation, in the direction of the line joining them, from the distance r to infinity. Then there would be involved the

$$\int_r^\infty dr/r^2 = 1/r. \quad (10)$$

Obviously therefore formulae (1), (2), (3) and (5) lead to the following expressions for the mutual potential energy of two circuits, namely:

[1] Paper presented in part at the March 30, 1946, meeting of the Philosophical Society of Washington. Received May 15, 1946.

[2] O'RAHILLY, ALFRED, *Electromagnetics—a discussion of fundamentals:* 519. 1938.

$$W = PI_1I_2 \oint\oint (3\cos\phi_1\cos\phi_2 - 2\cos\gamma)ds_1ds_2/r \quad (11)$$

$$W = PI_1I_2 \oint\oint \cos\gamma ds_1ds_2/r \quad (12)$$

$$W = PI_1I_2 \oint\oint \cos\phi_1\cos\phi_2 ds_1ds_2/r \quad (13)$$

$$W = PI_1I_2 \oint\oint \sin\phi_1\sin\phi_2 ds_1ds_2/r. \quad (14)$$

Of these expressions for the mutual potential energy of two circuits that given by formula (12) and generally attributed to Neumann has been used more than any other. That given by formula (13) will be found to work out best in case of a helix and a concentric circle in the plane of the end of the helix.

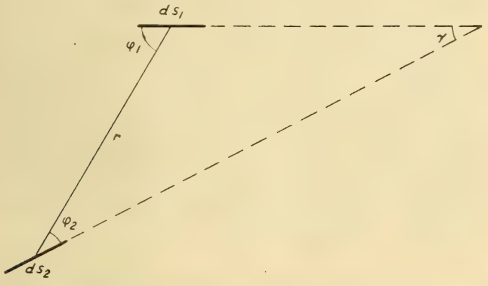


FIG. 1.—Diagram showing the geometry involved in formulae purporting to be statements of laws of force actions between elements of two linear circuits, in the special case in which ds_1 and ds_2 are coplanar. (DTM #7864.)

Formulae (11), (12), and (13) become identical on integrating around either circuit and on a second integration, that is, around the other circuit, give a result generally considered to be correct.

Formula (14) leads to the conclusion that there is no mutual potential energy associated with two adjacent circuits and consequently no force acting between adjacent coils of insulated wire in each of which there is a current. Thus, taking what O'Rahilly insists is the correct formula at its face value we are led by what apparently are proper steps to a conclusion contrary to what we find by experiment. However, it should be pointed out that his formula (4) may be juggled in such a way as to give a result in conformity with the result obtained by the use of either of the formulae (1), (2), or (3).

With reference to these force formulae, namely (1), (2), (3), (4), and (5), it is hardly appropriate to say that any one is correct or incorrect. No one has been proved or disproved by direct experiment. Except to the extent that (4) and (5) are equivalent, each is in definite conflict with every other. When applied to actual circuits formulae (1), (2), and (3) lead directly and (4) indirectly to the same result. Consequently no one of them should be considered to be a statement of a law of physics. They are merely postulates or working hypotheses which should be judged entirely on the basis of their usefulness in applied physics.

Here this matter has been discussed in such a way as to make the conclusions reached and those which may be reached independent of units. As illustrations consider the application of force formula (3) to a particular pair of circuits. Then if conditions are more or less ideal and if C is considered to represent the length $\oint\oint \cos\phi_1\cos\phi_2\, ds_1ds_2/r$, it follows that—

(1) The mutual potential energy of the system

$$W \text{ is } PI_1I_2C. \quad (15)$$

(2) The component in the direction x of the force, acting between the coils,

$$F_x \text{ is } PI_1I_2dC/dx. \quad (16)$$

(3) The effective permeability of the ambient space

$$P \text{ is } W/I_1I_2C. \quad (17)$$

(4) The product of the two currents

$$I_1I_2 \text{ is } F_x/PdC/dx. \quad (18)$$

(5) The mutual inductance of two coils and the ambient medium

$$M \text{ is } PC. \quad (19)$$

If formula (3) is combined with the experimentally established law for induced electromotive force and with Ohm's law it follows that a resistance

$$R \text{ is } PC/T \quad (20)$$

where T is the effective period of a recurring action in a mechanism which in one respect behaves like a resistor. (A Lorenz apparatus is one of several types of mechanism which in effect produce a potential drop or electromotive force proportional to an impressed current and consequently has associated with it a resistance.)

If R' is the resistance associated with a standard resistor and if by measurement it is found that $R' = \mathrm{AR}$ it follows that

$$R' = APC/T. \qquad (21)$$

It also follows that

$$P = R'T/AC. \qquad (22)$$

As to the significances of formulae (15) to (22) inclusive, all of which involve force formula (3), it should suffice to point out—

(a) That formula (20) serves to define resistance as a quantity of the electromagnetic system of measurements.

(b) That formula (21) serves in the measurement of the resistance associated with a standard resistor in terms of standards of length, time and permeability, and

(c) That formula (22) serves in a measurement of the effective permeability associated with an ambient space in terms of standards of resistance, time and length—that is, in the measurement of permeability as a quantity of the international system of measurements.

Possibly it should be explained that *as presently used* in applied physics—

(a) The electromagnetic system of measurements involves the use of length, mass, time and permeability as basic quantities and the definition of all units of the system in terms of standards of these 4 quantities.

(b) The international system of measurements involves the use of length, time, electromotive force and resistance as basic quantities and the definition of all units of the system in terms of standards of these four quantities.

It may be noted that it is not until a need for a law of physics, whether hypothetical as are the force laws considered here or experimentally established as is Ohm's law, has arisen does it become necessary to select a system of measurements.

Furthermore, having selected a system of measurements, it is not until it becomes desirable to record results of measurements that it becomes necessary to select standards, define units, and split experimentally established equalities of quantities into two equalities, one of numerics and the other of units of quantities.

BIOCHEMISTRY.—*Faits expérimentaux sur la stabilisation anti-oxygénée de la bilirubine par les protéines plasmatiques et hypothèse sur la nature de la cénapse albumino-bilirubinique du plasma.*[1] G. Barac, et R. Roseman (Baltimore, Md.)[2], Institut de Clinique et de Policlinique Médicales, Université de Liége, Belgique (Directeur: Prof. Dr. L. Brull). (Communicated by James I. Hoffman.)

INTRODUCTION

Les recherches de l'un de nous sur le mécanisme de l'élimination rénale de la bilirubine l'ont amené à étudier l'état physico-chimique du pigment dans le plasma, après qu'il eut constaté que la bilirubinémie totale n'est pas le seul facteur qui règle la bilirubinurie (*2*). D'ailleurs, l'importance de l'état physico-chimique des constituants plasmatiques, au point de vue de leur élimination rénale, a été démontrée, dans cet Institut, par Brull, dans un travail fondamental en 1930 (*8*). En ce qui concerne la bilirubine, s'il est actuellement établi (*10, 13, 14*) que, dans le plasma, elle est liée à l'albumine, il n'existe, par contre, à notre connaissance, aucun fait expérimental permettant une hypothèse concernant l'endroit de la molécule bilirubinique où cette liaison s'effectue.

[1] Received March 1, 1946.

[2] Nous exprimons notre vive gratitude à Monsieur le Professeur E. J. Cohn, Department of Physical Chemistry, Harvard Medical School, et à Monsieur le Professeur H. Neurath, Department of Biochemistry, Duke University School of Medicine, qui ont eu la grande amabilité de mettre à notre disposition les cinq fractions de protéines plasmatiques et les albumines cristallisées, utilisées au cours de nos recherches.

Et cependant, la connaissance de cet endroit serait d'une grande importance, au point de vue du mécanisme biochimique de la bilirubinurie. En effet, comme la bilirubinurie ne s'accompagne généralement pas d'albuminurie, il en résulte que: (1) la bilirubine doit être séparée de sa cénapse avant son apparition dans l'urine; (2) suivant l'endroit de la molécule bilirubinique où sa liaison avec l'albumine est réalisée, ainsi que d'après la nature de cette dernière, la séparation du pigment reconnaîtra forcément des mécanismes biochimiques différents. En effet, si, par exemple, la bilirubine est combinée à l'albumine par les fonctions carboxyles du pigment, si, en d'autres mots, il s'agit d'un bilirubinate d'albumine, la scission se fera suivant un tout autre processus que si cette liaison a lieu au niveau d'une autre fonction et par un moyen différent.

Partant du fait que l'acide ascorbique ainsi que certains autres anti-oxygènes et réducteurs, à micro-molécules, stabilisent la bilirubine en solution alcaline (*1*, *3*), ayant constaté, d'autre part, que le plasma normal, additionné de bilirubine ou le plasma ictérique, tous les deux alcalinisés, agissent de la même façon (*4*), l'un de nous s'est attaché à l'étude du mécanisme de cette réaction. Il a pu démontrer que les protéines plasmatiques totales délipidées et, dans une certaine mesure, une préparation d'albumine plasmatique, non purifiée, sont actives, cependant que divers lipides, examinés isolément, ainsi que l'ensemble des lipides plasmatiques chloroformo-solubles sont sans effet. La conclusion de ces recherches fut que la stabilisation anti-oxygénée de la bilirubine dans le plasma était due très vraisemblablement aux protéines, voire surtout à l'albumine. Et comme la différence chimique entre la bilirubine et sa forme oxydée la biliverdine se caractérise par la transformation du groupe méthane, reliant les deux noyaux pyroliques du milieu, en méthine, il était à supposer que, dans le plasma, c'est en cet endroit de la molécule bilirubinique que l'albumine agit comme anti-oxygène par sa liaison avec le pigment. Suivant cette interprétation, l'orientation de la molécule bilirubinique était telle que ses fonctions carboxyles étaient dirigées vers la phase aqueuse du milieu. Cette explication, toute provisoire, demandait de nouvelles expériences, notamment au moyen de protéines plasmatiques plus individualisées.

Grâce à l'aide bienveillante du Laboratoire de Chimie Physique de l'Université Harvard et à celle du Laboratoire de Biochimie de l'Université Duke, qui ont bien voulu mettre à notre disposition une série de protéines plasmatiques, nous avons pu entreprendre ces recherches. Les résultats obtenus jusqu'à présent constituent la première réalisation de notre programme dans ce domaine et forment une partie des données de ce travail.

OBJET DU TRAVAIL

(1) L'albumine plasmatique est-elle réallement anti-oxygène vis-à-vis de la bilirubine?

(2) Peut-on obtenir cet effet stabilisateur avec n'importe quelle protéine plasmatique?

(3) Peut-on obtenir un résultat analogue avec l'un des acides aminés constituant la molécule albuminique ou avec le mélange de tous les acides aminés de cette molécule, à la concentration de l'albumine plasmatique habituelle, ou bien s'agit-il d'une propriété de la molécule albuminique, considérée comme telle?

(4) La propriété anti-oxygène du plasma se manifeste-t-elle, dans les mêmes conditions, également vis-à-vis d'autres molécules facilement oxydables tels certains polyphénols?

TECHNIQUE DES MESURES

Nous utilisons comme méthode d'analyse la photométrie directe du pigment et comme appareil le photomètre graduel de Pulfrich. Nous nous servons du filtre S_{43}, auquel correspond le maximum d'absorption du pigment dans ces conditions, ainsi que l'un de nous l'a établi précédemment au moyen de cet appareil (*1*) et confirmé ses résultats avec A. Lambrechts, en utilisant la méthode spectrophotométrique visible (*11*).

RÉSULTATS EXPÉRIMENTAUX

Vitesse d'oxydation de la bilirubine en solution alcaline pure.—7,5 mgr. de bili-

rubine Hoffmann-LaRoche, identique à celle de Fischer, d'après Heilmeyer, sont dissous dans un litre de NaOH N/100. La solution est conservée au laboratoire, à la lumière ordinaire, au contact de l'air. Elle est suivie périodiquement au photomètre. La Fig. 1 montre que le maximum de la transformation subie par la bilirubine a lieu pendant les 7 premières heures et que dans la suite elle se ralentit considérablement.

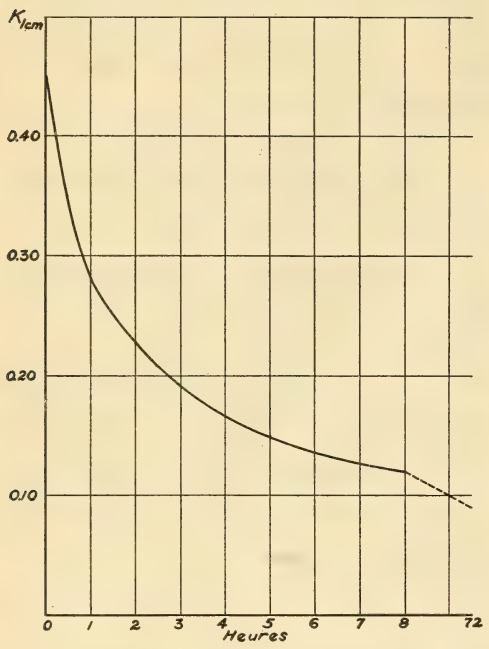


FIG. 1.—Vitesse d'oxydation de la bilirubine en solution alcaline pure.

Protéines et stabilisation anti-oxygénée de la bilirubine en milieu alcalin. Essais avec les solutions d'albumine Cutter et de globuline Lilly.—En partant d'une solution d'albumine Cutter, utilisée pour transfusion, et d'une solution de globuline Lilly, nous préparons, par dilution, au moyen de NaOH N/100, des solutions ayant respectivement 90 et 84 gr. de protéines p. 1000. A chacune nous ajoutons de la soude solide jusqu'à obtention d'un pH de 10, vérifié au moyen du papier indicateur Merck. Chaque solution est alors partagée en deux parties. A l'une nous ajoutons un volume égal de soude centinormale. Elle servira de témoin. A l'autre, nous ajoutons un volume égal d'une solution fraîchement préparée de bilirubine à 15 mgr. p. 1000 de NaOH N/100. Chacune des solutions bilirubiniques est photométrée périodiquement avec son témoin correspondant, la différence des valeurs enregistrées correspondant à la bilirubine seule. Le Tableau 1 contient les résultats obtenus. On voit que dans la solution albuminique la bilirubine reste stable au moins pendant 73 heures, et que dans la solution de globuline la stabilité du pigment dure 3 heures.

Essais avec les diverses fractions de protéines plasmatiques "Harvard."—2 gr. de chaque fraction (*9*) sont additionnés progressivement de NaOH N/100 jusqu'à obtention d'un volume de 25 cc. On agite au moyen d'une baguette en verre pour obtenir une dissolution complète. Comme ci-dessus, nous ajoutons de la soude solide pour obtenir un pH de 10. La moitié du volume de chaque solution est additionnée d'un volume égal de NaOH N/100 et sert de témoin, à l'autre moitié on ajoute un même volume de bilirubine à 15 mgr. p. 1000 dans NaOH N/100. Les examens ont lieu comme ci-dessus. Les résultats figurent au Tableau 1. On voit que seule la fraction V, comprenant 100 p. 100 d'albumine, est nettement active puisqu'elle stabilise la bilirubine au moins pendant 30 heures.

Essais avec deux albumines plasmatiques cristallisées "Duke."—Nous avons réalisé des essais avec deux albumines plasmatiques cristallisées, l'une humaine, l'autre bovine. La préparation des solutions bilirubiniques et témoins est la même que ci-dessus, la concentration en albumines étant de 40 gr. p. 1000. Nous donnons dans le Tableau 1 les résultats obtenus. Ceux-ci montrent que dans ces milieux la bilirubine est stable au moins pendant 7 heures et que dans la suite il y a une légère diminution de cette stabilité.

Acides aminés et stabilisation anti-oxygénée de la bilirubine en milieu alcalin. Action des acides aminés examinés isolément.—La molécule d'albumine plasmatique comprend 13 acides aminés. En suivant les données de Lehnartz (*12*), nous avons utilisé pour chaque acide aminé sa concentration albumino-plasmatique correspondant à 45 gr. d'albumine par litre.

TABLEAU 1

Solutions protéiques additionnées de Bilirubine	K_1 cm. Init.	K_1 cm. après 1 H.	K_1 cm. après 2 H.	K_1 cm. après 3 H.	K_1 cm. après 4 H.	K_1 cm. après 5 H.	K_1 cm. après 6 H.	K_1 cm. après 7 H.	K_1 cm. après 8 H.	K_1 cm. après 9 H.	K_1 cm. après 10 H.	K_1 cm. après 24 H.	K_1 cm. après 30 H.	K_1 cm. après 48 H.	K_1 cm. après 73 H.
Cutter	0.45	0.46	0.43		0.45		0.43		0.43		0.45	0.45	0.45	0.43	0.43
Lilly	0.48	0.48		0.45		0.44	0.42	0.40	0.41			0.35			
Protéines Harvard															
Fract. I	0.42	0.30	0.26	0.25		0.19	0.17								
Fract. II	0.41	0.31		0.24	0.20	0.22		0.21		0.19					
Fract. III	Insoluble														
Fract. IV	0.46	0.40		0.30		0.28									
Fract. V	0.42	0.43		0.42		0.42		0.41		0.41	0.40	0.40	0.42	0.38	0.35
Albumines cristallisées Duke															
Humaine	0.51	0.50			0.50		0.50	0.49	0.47	0.45		0.44	0.45		
Bovine	0.48	0.46			0.46		0.46	0.46	0.46	0.41		0.42	0.42		

Les valeurs de K (coefficient d'extinction) de ce Tableau représentent la différence des coefficients d'extinction des solutions bilirubiniques et de leurs témoins correspondants.

TABLEAU 2

Solution d'ac. aminé +Bilirubine	K_1 cm. In.	K_1 cm. après 30'	K_1 cm. après 1 H.	K_1 cm. après 2 H.	K_1 cm. après 3 H.	K_1 cm. après 5 H.	K_1 cm. après 8 H.	Remarques
Alanine	0.60	0.58	0.53	0.49	0.45	0.36	0.33	
Leucine	0.16	0.17	0.14					Verdissement rapide de la solution dès l'addition de la solution de bilirubine.
Ac. glutamique	0.58	0.53	0.50	0.46	0.42	0.33		
Ac. aspartique	0.17	0.15	0.12					Même remarque.
Sérine d.l.	0.37	0.24	0.18		0.04			Même remarque.
Cystine l.	0.48	0.39	0.33	0.27	0.25	0.22	0.21	
Lysine l.	0.32	0.20	0.19		0.12			Même remarque.
Arginine d.	0.51	0.42	0.37		0.28	0.22	0.15	
Phénylal. d.l.	0.21	0.12	0.09		0.07			Même remarque.
Tyrosine	0.53	0.53	0.50	0.45	0.40			
Proline l.	0.51	0.46	0.43		0.32	0.29	0.20	
Histidine	0.55	0.55	0.52	0.47	0.40			
Tryptophane l.	0.49	0.41	0.38		0.29	0.25	0.21	
Mélange des 13 ac. aminés +Bilirubine	0.47	0.33	0.25	0.20	0.18	0.16	0.12	

TABLEAU 3

Filtre S.	K_3 cm. Sol. aq. alc. de Hydroq.	K_3 cm. Sol. aq. alc. de Pyrog.	K_3 cm. Sol. aq. alc. de Adrén.	$K_{0.5}$ cm. Plasma I alc. tel quel	$K_{0.5}$ cm. Plasma I alc.+ Hydroq.	$K_{0.5}$ cm. Plasma II alc. tel quel	$K_{0.5}$ cm. Plasma II alc.+ Pyrog.	$K_{0.5}$ cm. Plasma II alc.+ Adrén. Init.	$K_{0.5}$ cm. Plasma II alc.+ Adrén. après 8 H.
43	0.23	1.00	0.14	0.43	0.60	0.27	0.72	0.32	0.61
47	0.19	0.62	0.07	0.38	0.56	0.26	0.61	0.29	0.40
50	0.15	0.36	0.02	0.31	0.46	0.18	0.45	0.18	0.25
53	0.09	0.25	0.01	0.20	0.37	0.07	0.28	0.04	0.09
57	0.03	0.14	0	0.14	0.33	0.03	0.16	0.02	0.04
61	0	0.10	0	0.13	0.25	0.02	0.11	0	0.02
66.6	0	0.03	0	0.11	0.17	0	0.05	0	0
72	0	0	0	0.08	0.09	0	0	0	0
75	0	0	0	0.09	0.09	0	0	0	0

La quantité de chaque acide aminé correspondant à 100 cc. de solution est neutralisée par de la soude à 10 pour-cent puis ajoutée de NaOH N/100 jusqu'à 50 cc et de 50 cc de bilirubine à 15 mgr. p. 1000 de NaOH N/100. Le Tableau 2 donne les résultats obtenus. Ceux-ci indiquent que pas un seul acide aminé ou plus exactement pas un seul dérivé sodique correspondant n'est anti-oxygène vis-à-vis de la bilirubine.

Action du mélange de ces 13 acides aminés.—Dans cette expérience nous procédons comme ci-dessus, en opérant sur le mélange de ces 13 acides aminés. Le Tableau 2 contient les résultats obtenus. On voit que dans ce milieu la bilirubine s'oxyde pratiquement avec la même vitesse qu'en solution alcaline pure.

Cas particulier de la cystéine.—Les solutions sont préparées d'après le procédé ci-dessus en utilisant les concentrations suivantes de chlorhydrate de cystéine: 470, 235, 100, 50, 25, mgr. pour-cent. Les résultats obtenus montrent qu'à partir de la concentration de 100 mgr. p. 100, la cystéine est nettement active. Toutefois, à concentration égale, son activité est moindre que celle de l'acide ascorbique.

Essais sur la stabilisation anti-oxygénée de quelques polyphénols facilement oxydables dans le plasma alcalinisé.—Nous avons opéré sur les polyphénols suivants: hydroquinone, pyrogallol, adrénaline. Comme on sait, ces polyphénols s'oxydent en solution alcaline en dérivés colorés.

Absorption visible des dérivés colorés de ces polyphénols en solution alcaline pure.—20 mgr. de chaque polyphénol p. 1000 de solution, sont dissous dans de la soude N/100. Les couleurs développées instantanément sont analysées immédiatement au photomètre.

Absorption visible des dérivés colorés de ces polyphénols dans le plasma alcalinisé.—Deux plasmas humains frais, citratés au dixième, sont alcalinisés à pH 10, au moyen de soude solide. A 10 cc du premier plasma on ajoute 7 mgr. d'hydroquinone. Le deuxième plasma est partagé en trois échantillons. A deux d'entre eux on ajoute respectivement 5 mgr. de pyrogallol et la même quantité d'adrénaline, le troisième servant de témoin. A l'exception du plasma additionné d'adrénaline où la coloration se développe lentement, les deux autres plasmas additionnés d'hydroquinone et de pyrogallol changent très rapidement de couleur. Le Tableau 3 réunit les résultats obtenus pour ces polyphénols en solution aqueuse alcaline ainsi que dans les plasmas alcalinisés de même que l'absorption de ces derniers avant l'addition de ces substances. On voit, d'après ces résultats, que le plasma alcalinisé n'est pas antixoygène vis-à-vis de l'hydroquinone et du pyrogallol, mais que, par contre, il empêche l'oxydation de l'adrénaline pendant une certaine durée (*6*, *7*).

DISCUSSION

Les résultats expérimentaux décrits dans ce travail montrent tout d'abord que l'oxydation de la bilirubine en milieu alcalin est considérablement retardée par l'albumine plasmatique, confirmant ainsi l'hypothèse de l'un de nous sur le rôle de cette protéine dans l'effet anti-oxygène du plasma vis-à-vis de ce pigment. En effet, nous avons obtenu ces résultats non seulement avec la solution d'albumine Cutter, mais également avec la fraction V Harvard, ainsi qu'avec deux albumines plasmatiques cristallisées, l'une humaine, l'autre bovine. Ils montrent, de plus, que la seule présence d'une protéine quelconque n'assure pas nécessairement cette stabilité, car parmi les différentes fractions de protéines Harvard expérimentées, seule la fraction V, contenant 100 pour-cent d'albumine, est nettement active. On peut évidemment se demander comment il se fait que la solution de globuline Lilly est douée d'une certain activité. Remarquons tout d'abord que nous ignorons la composition de cette solution en ce qui concerne sa teneur en substances réductrices et autres stabilisateurs éventuellement présents. D'autre part, nous avons opéré, dans ce cas, sur une concentration de globuline voisine de celle de l'albumine plasmatique pour comparer l'activité de ces deux espèces de protéines. Cette concentration est, par contre, trop éelvée lorsqu'on envisage la teneur globulinique totale du plasma normal ou ictérique. Ce-

pendant, nous n'excluons pas actuellement la possibilité d'une certaine activité anti-oxygène des globulines plasmatiques vis-à-vis de la bilirubine, mais nous estimons que la question demande de nouvelles recherches que nous n'avons pas encore réalisées faute de produits. Notons d'autre part, que l'action de l'albumine n'est pas uniquement de nature colloïdale. L'un de nous, a en effet montré précédemment que ni la gomme arabique, ni l'amidon, ni le glycogène ne sont anti-oxygènes vis-à-vis de la bilirubine, quoiqu'utilisés à concentration élevée.

Un deuxième fait qui résulte de nos expériences est le suivant: la propriété anti-oxygène du plasma alcalinisé n'est pas générale puisqu'elle ne s'exerce pas à l'égard d'autres substances facilement oxydables, tels certains polyphénols.

Si l'on compare maintenant la durée d'activité des solutions d'albumine Cutter, fraction V Harvard, albumines cristallisées Duke, sensiblement de même concentration en albumines, on voit que la difference est assez appréciable. Nous ignorons actuellement la signification de celle-ci.

Nous attirons d'autre part l'attention sur l'inactivité totale des acides aminés constituant la molécule albuminique, examinés isolément ou en mélange. Nous poursuivons nos recherches dans ce domaine.

CONCLUSIONS

(1) A la concentration albumino-plasmatique habituelle, l'albumine plasmatique est anti-oxygène à l'égard de la bilirubine en milieu alcalin.

(2) Cette action anti-oxygène n'est pas commune à toutes les protéines plasmatiques.

(3) Cette propriété de l'albumine est due à sa molécule envisagée comme telle.

(4) La propriété anti-oxygène du plasma alcalinisé est nulle vis-à-vis de certains polyphénols facilement oxydables, dans les mêmes conditions où elle se manifeste à l'égard de la bilirubine.

(5) Les expériences décrites dans ce travail sont en faveur de l'hypothèse suivant laquelle, dans le plasma, la liaison albumino-bilirubinique se ferait de telle façon que les fonctions carboxyles de la bilirubine seraient orientées vers la phase hydrique du milieu.

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ETHNOLOGY.—*Susquehannock Indian religion from an old document.*[1] C. A. Weslager, Archaeological Society of Delaware.

In 1943 a translation was made by Ira Oliver Nothstein of a graduation dissertation submitted June 14, 1731, to the faculty of Upsala University by Tobias Biorck, a Swedish student.[2] The dissertation was written in Latin according to the custom of the time. Apparently no importance was attached to it, inasmuch as it remained untranslated for more than 200 years. The student, as we know today, was the son of the Rev. Eric Biorck, a missionary sent to America in 1697 by Charles XI of Sweden. He served as minister of the Holy Trinity (Old Swedes) Church in Wilmington, Del., where his oldest son, Tobias, was born. When the minister and his family returned to Sweden in 1714, Tobias was then 11 or 12 years old. The dissertation which he later presented at Upsala described the planting of the Swedish Church in America and contained among other things a section devoted to native custom and religion. To the student of the American Indian these comments by a contemporary observer are worthy of careful review, especially since they relate to a tribe of Indians now considered extinct, the Susquehannock, alias the Minquas, an Iroquoian-speaking tribe that occupied the Susquehanna River region in Pennsylvania. It should be emphasized that of the few contemporary accounts relating to the Susquehannock nothing of their religion and little of their cultural pattern have been previously recorded.[3]

When the present writer undertook the preparation of a paper calling attention to that part of the translation dealing with the Susquehannock religion he found that a prior translation had been made by the late Walter Hullihen, president of the University of Delaware.[4] In comparing Hullihen's unedited and unpublished translation of the Indian section with that made by Nothstein, the writer was confronted with major differences in interpretation, and it became obvious that a third translation was needed to resolve the discrepancies. Miss Evelyn Holst Clift, a member of the faculty of the Department of Ancient Languages, University of Delaware, was consulted, and she subsequently made a third translation, carefuly comparing the differences in the two prior translations. It should be emphasized that she worked only with the Indian excerpts of the manuscript, disregarding the ecclesiastical portions relating to the Swedish Church. Miss Clift states that she finds that her translation more closely resembles Hullihen's, with some alterations, than it does Nothstein's. Her translation follows, with footnotes by the present writer:

Let us now come to the Indians, the ancient race of the American land, whom the Swedes call *Wildar*, unquestionably because they exist as wild men in the forests and deserted places. America is so crowded with them that it is believed that 300 separate peoples are found there using each a different tongue. They are said, however, to be growing less and less numerous

[1] Received June 18, 1946.

[2] *The planting of the Swedish Church in America*, by Tobias E. Biorck, translated and edited by Ira Oliver Nothstein, D.D., Augustana College, Rock Island, Ill., 1943.

[3] John Smith wrote the first detailed account of these Indians whom he called the "Sasquesahanocks," commenting on their large stature and warlike nature. He said: "They can make neere 600 able and mighty men, and are pallisadoed in their Townes, etc." *Travels and works of Captain John Smith*, edited by Arber and Bradley, p. 54. Edinburgh, 1910.

A complete record of the historical references to the Susquehannock is given by H. Frank Eshleman, *Lancaster County, Pa. Indians*, Lancaster, Pa., 1908, and their geographical position is discussed by William N. Fenton, "Problems Arising from the Historic Northeastern Position of the Iroquois," Smithsonian Misc. Coll. **100**: 159–251.

Previous to 1763 the Susquehannock, also known as the Conestoga, are frequently mentioned in the *Colonial Records of the State of Pennsylvania*. These documents show that the Susquehannock had been defeated by the Five Nations Iroquois and their numbers greatly reduced as a result of warfare. In 1763 remnants of the tribe were exterminated by Scotch-Irish fanatics, the so-called Paxton Boys, near Harrisburg. For an account of this massacre see C. Hale Sipe, *Indian wars of Pennsylvania:* 463. Harrisburg, 1931.

[4] A typewritten copy of this translation is available at the Memorial Library, University of Delaware, Newark, Del.

and to be almost disappearing. Some of these are more powerful than others. We note now only the heathen *Minckusi* as being among the braver, around *Canistowa* and *Susquehana*.[5] They received the first Swedish settlers in America with such kindly feeling that, when other heathens wished to attack the Swedes with weapons, they came to their defense saying: "You must leave them in peace and quiet. But, if you wish to fight, you must fight with us." Hence, too, they called them *Hissimus*, that is, brothers (in their tongue).[6] Their territories are customarily described as to boundaries by rivers and certain hills. The king has a common name, *Sacheman*, meaning the same as "Dominus" (Lord). This "domination" in truth is especially noticeable in the handling of matters of greater importance, whether in connection with other heathens or with the Christians. In all other matters he is no more than equal of the rest. In very many particulars the customs and lives of these people are identical in type with the life of the Lapps. They are tall of stature and very erect.[7] Moreover, they are faithful, chaste, just, compassionate, not miserly, and happy in disposition. But in the treatment of captives they are rather severe.

As far as their religion goes, if it is to be called a religion, they recognize two Gods or spirits, which they call *Manetto's*. They say that the one is the ruler of celestial matters, the other of terrestrial. They perversely believe that the first, since he is good, need not be worshiped or feared, but that the second because he is evil is to be both feared and worshiped. Master A. Hesselius has portrayed the form of this (divinity) just about as it was cut on the door of a Swedish-American settler.[8] They indulge in various superstitions, taking an omen from various birds, snakes, and other animals which seem more fitting to them. As familiar spirits (genii) and household gods they have images of these objects of superstition, which they carry with them, ascribing to them their successes in hunting and every other fortunate event. It is even a custom at times for the images of these household gods to be inscribed and pricked on their arms and bones with a certain kind of thorn in such a way that they remain indelible; furthermore, it is customary for them to be cut into trees so that one can see from them what heathens are dwelling in this or that tract of land or have had their domiciles there before.

That after this life our heathens expect a

[5] Canistowa refers to Conestoga, a name used to refer to a creek and also Indian settlements on the creek. Biorck uses "Minckusi" to designate the Minquas or Susquehannock tribe. Lindeström uses the word "Minquesser" (see *Geographia Americae*, PETER LINDESTRÖM, translated by AMANDUS JOHNSON. Philadelphia, 1925). There is no doubt that Biorck has delimited his comments to the Minquas as the above text clearly reveals.

[6] Other contemporary documents confirm Biorck's statement that the Minquas and Swedes were on very friendly terms. Gov. Johns Rising wrote that the Minquas considered them as their "protectors." This relationship was a product of a deliberate attempt on the Swedes' part to cultivate friendship with the Minquas because of the great quantities of beaver pelts obtainable in the Minquas country. See AMANDUS JOHNSON, *The Swedish settlements on the Delaware*, vols. 1 and 2. Philadelphia, 1911.

[7] Note that John Smith also wrote that these Indians were tall.

[8] Andreas Hesselius, who succeeded the senior Biorck as minister as the church in Wilmington, left a journal to which Tobias Biorck refers in the above. The Journal was published in Swedish at Upsala, 1938, *Andreas Hesselii Anmarkningar Om Amerika*, by NILS JACOBSSON, but no English translation has yet been published. Under date of June 10, 1712, Hesselius entered the following in his Journal:

"Såg iag hoos en swensk Handelsman en figur, som Indianerna sielfwa hade målat sin Manettos skapnad, med then the fruchta och dyrcka: Liknelsen kommer närmast til ett warg-Hufwud, some grijnar och pustar uth eld och röök: Kroppen är en drakekropp, mycket tiock, men smalnar ut wid stiertten, ther några sällsamma kruus och characterer synas: Eljest hafwer Kroppen inga fötter eller wingar, untan allenast ett par uträckta armar och händer med kloor på fingren utspände til at grijpa något."

A free translation of the excerpt would be approximately as follows:

"I saw a figure which the Indians themselves had painted at a Swedish merchant's, the image of their Manetto, whom they fear and worship: the figure nearest resembles the head of a wolf, grinning grimly and emitting fire and smoke, the body is like the body of a dragon, very thick but tapering at the tail where some peculiar ornaments and characters are seen. There are no feet or wings attached to the body. Only a pair of arms stretched forth, the fingers of the hands were provided with claws and those extended as if they were about to take hold of something."

In his graduation dissertation Tobias Biorck included a sketch of the figure which he identifies as "*Manetto Indianorum.*" (See illustration, p. 33, of the Nothstein translation.) His sketch conforms closely with the above description. It should be noted that both Iroquois and Algonkian religious concepts included a "holder of the heavens" and an "earth bound twin brother," which are doubtless the basis for the above remarks relating to "good" and "bad" Manito.

more blessed one is indicated by the pipes, tobacco, and bottles made of animal skins, etc., which the others deposit in the mounds with the bodies. This they do in token of friendship, in order that, wheresoever the entrance to the better life befalls them at some time they may themselves enjoy the same furnishings. All days are held by them at one and the same value. No one is more sacred to them than another. In their sacrificial services, through which they believe the evil spirit is appeased so that nothing unfortunate may rush upon them, they behave in so many different ways that they would drive any sane person to stupefaction, even to amazement. These sacrifices, according to the matter in hand and the season of the year, are made with first-fruits of the harvest, of the hunt, of fishing, etc. The program and plan in accordance with which these (sacrifices) are instituted will be immediately apparent from the twofold example which is here appended.

The first sacrifice, after the successful hunt of a stag, is said to have been as follows: some people, a few, surrounded a hut which had been duly constructed and covered with bark and skins. Where the sacrificer had put tobacco on top of little stones which had been brought into the hut and heated with fire, another man, following him, poured water over them. Wherefore, because smoke thereupon rises on high, in like manner the sacrificer saying in a higher voice, repeated, *Kännäka, kännäka,* or sometimes hoo, hoo, turns his face toward the east. Moreover, when the sacrificer had become silent, the others, sitting near, made ridiculous sounding noises as they tried to imitate the uncouth sounds, some of the African cock [guinea-hen?] others of the squirrel, others of other animals. Amid this noise there were distributed to the guests two roasted stags, with bread made out of grain, ground *Majis* (which we usually call Turkish wheat) called by them *Kankis.*[9] Moreover, the sacrificer ate nothing meanwhile.[10]

The second example Master A. Hesselius saw with his own eyes. This sacrifice was made from the first-fruits of roots which are not very different from nuts and are dug up by the heathens in the swamps; they are there [i.e., among the heathens] called *Tachis,* in English hopnuts. These, first dried by the heat of the sun, they cook beneath the open sky in a jar or a bronze kettle placed on the fire. While this culinary operation is being conducted and while the others are leaping around in a circle, an Indian woman finally comes forth, with her hair loosened over her shoulders, and with a spoon stirs the food again and throws a part of the same food into the fire, an action which those dancing around approve by the shout which they utter. Afterwards they consume the food as if it were food prepared on this occasion for themselves. These and other sacrifices of the Americans are usually called, in their native language, *Kinticka,* that is a rather well-known [or rather crowded] gathering or wedding.[11]

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[9] This obviously refers to corn.

[10] Some similarities between this ceremony and a sacrificial feast recorded by Zeisberger among the Delawares may be distinguished. See DAVID ZEISBERGER, *History of the North American Indians,* ed. by HULBERT and SCHWARZE: p. 137. FRANK G. SPECK, *Oklahoma Delaware ceremonies, feasts and dances,* p. 59, 1937, also discusses sacrifice feasts among the Delawares wherein family groups often celebrate the first taking of produce of the chase. Dr. William N. Fenton, of the Bureau of American Ethnology, in a personal letter dated August 10, 1945, has kindly given me the following information relative to a Five Nations rite, which bears some similarities to Biorck's account:

"In September, about the time of the first deer hunt, the Little Water Medicine Society meets to renew the strength of the Medicine. At this session four groups of songs are sung of which the third, sung only at this meeting, is to renew the fur on the animals who then don winter coats. Certain aspects of the ceremony suggest that the original meetings were held in a sweat lodge. A basket of tobacco is set out for the members to contribute a share. Some of this is used to invoke the spirit members, the animal tutelaries, and the rest is smoked. At Tonawanda pinches of tobacco are set out for each group of songs—eight in all—four pinches and two pinches per group for the male and female songs. Between songs when the fire is down, they raise up the light—kindle the fire and pass berry water. At the end is a terminal feast. The conductor passes a hog head, anciently a bear or deer head, and all the members Kah Kah! like crows or buzzards picking at a dead carcass. There is also cornbread, I think. . . . I do not recognize [the meaning of] Kännäka."

[11] As in the first ceremony described, there are elements in the second suggestive of both Algonkian and Iroquoian rites. The use of fire is reminiscent of the fire symbolism among the Delawares described by FRANK G. SPECK, *Delaware Indian Big House Ceremony:* 47. Harrisburg, 1931. The Delawares were not pyrolatrists, but fire, as a spirit force, subordinate to the Great Spirit, was considered an agency of purification and invigoration. Similarly, the sacrifice of the first fruit also harks back to Delaware religious beliefs. SPECK, *ibid,* p. 12, discusses and analyzes

CONCLUSIONS

The description written by Tobias Biorck purports to be an account of certain customs and religious practices of the Minquas or Susquehannock Indians. His information was based on boyhood observation in America and information received from Andreas Hesselius and doubtless from his father Erick Biorck. While his remarks are inconclusive, nevertheless they represent the only contemporary account of Susquehannock ceremonial rites and as such warrant consideration. It would be extremely hazardous to draw conclusions from the comments of a European who was unschooled in ethnological techniques and who entertained religious prejudices; nevertheless, in the absence of other data, the account must be accepted at face value. According to details given by Biorck, the Susquehannock, although an Iroquoian-speaking people seem to have practiced ceremonial rites akin to the Delaware, an Algonkian people. Since the latter are believed to have been the older occupants of the region, one may be justified in inferring that the Susquehannock ceremonial pattern had undergone change due to Algonkian influence.

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the term "kinticka" or "ka'ntika," meaning "he is dancing."

In addition, the ceremony described could well resemble an earlier Iroquois ceremony of the pattern described by William N. Fenton, *Tonawanda Longhouse Ceremonies: Ninety Years After Lewis Henry Morgan*, Bur. Amer. Ethnol. Anthrop. Papers, No. 15. Smithsonian Institution, 1940."

ENTOMOLOGY.—*Descriptions of three new species of mosquitoes of the genus* Aedes, *subgenus* Finlaya, *from New Guinea.*[1] WILLARD V. KING, Colonel, and HARRY HOOGSTRAAL, Captain, Sn.C., A.U.S. (Commnicated by ALAN STONE.)

Aedes (Finlaya) tsiliensis, n. sp.

This is a distinctive species, characterized by a large white scutal patch, white markings on the femora and tibiae, and apical as well as basal white rings on the first segment of the mid and hind tarsi.

Male.—Head: Proboscis dark-scaled, slightly longer than fore femur. Palpus about as long as proboscis; long segment with a white ring in the middle, apical segment completely white, sub-apical segment all dark; long slender bristles ventrolaterally from last two segments and apex of long segment. Antenna almost as long as proboscis, densely plumose, the long hairs directed mostly in two planes. Clypeus black, nude. Scales of vertex narrow curved, a median area silvery white, bordered on each side by an area of dark and scattered white scales, a patch of broad white scales laterally extending forward as a narrow line along eye margin; numerous upright forked scales on vertex, palest in median area. *Thorax:* Scutum covered across front half with coarse, lanceolate, silvery-white scales, continued over upper half of posterior pronotum. (Central part of disk of holotype and paratypes rubbed, with a few remaining fine white scales posteriorly. The original notes on this species read: "Mesonotum with a striking patch of linear white scales across front half and upper part of *ppn* and a broad line around antescutellar space.") Scutellum with narrow and lanceolate silvery-white scales on each lobe (partly rubbed). Postnotum black, nude. Anterior pronotal lobe largely covered by broad silvery-white scales and long black bristles. Posterior pronotum covered on upper half with narrow silvery-white scales, smaller than those on scutum. Postspiracular area black with about six bristles. Patches of broad silvery-white scales on upper and lower posterior sternopleuron, on paratergite, in front of prealar bristles, and a wide patch on mesepimeron curving from upper posterior to middle anterior borders; no lower mesipmeral bristle. Propleuron with broad silvery-white scales and about six bristles. Wing length 3 mm; scales dark except for a short line of white scales at base of costa and vein 1; lateral scales of veins 2 to 4 elongate, those on the tips

[1] From the 19th Medical General Laboratory, U. S. Army. Contribution No. 11 from the Entomology-Mammalogy Department. Received July 2, 1946.

slightly shorter and broader; anterior fork cell about one and a half times as long as its stem arising slightly closer to base of wing than posterior cell; posterior cross vein closer to base of wing than mid by more than its own length. Haltere stem yellowish, knob dark. Coxae with patches of silvery-white scales. Fore femur dark, with a narrow basal white ring and a large white spot midway of posterior surface; mid femur similar but in addition with a conspicuous apical white spot; hind femur completely white on basal half, the apical half dark except for an apical white ring, lengthened below. Fore tibia with an anterior apical white spot about one-fifth its length, the posterior surface entirely dingy white; mid tibia with a narrow subapical white ring extending basad as a line to middle on dorsal surface; hind tibia with a small dorsal apical white spot only. Fore tarsus all dark; mid tarsal segment 1 with a white ring on basal and apical thirds, segment 2 white on basal third; hind tarsus with a basal white spot and a narrow apical ring on segment 1, and a narrow basal ring on segment 2; other segments all dark; fore and mid tarsal claws subequal, the larger claw toothed. *Abdomen:* Tergites IV to VI with dorsal basal median white spots about half length of segment, narrowly separated from lateral spots; tergites II, III, and VII with median spots much smaller; large basal lateral silvery spots on tergites II to VII, those on anterior segments about half length of segment, on posterior segments almost full length; tergite VIII almost entirely silvery-scaled; sternites silvery basally, black apically, without erect scale tufts; coxites silvery-scaled on outer surfaces. *Hypopygium* (Fig. 1, from a paratype): Coxite four times as long as mid width, strongly compressed laterally, the outer surfaces densely clothed with scales and bristles; subbasal lobe in the form of an elongate ridge covered with long bristles; apical half of coxite with a dense patch of long, striated, pointed scales along the inner margin of the lower fold and fine bristles from the upper fold. Style two-fifths as long as coxite, slender, curved, finely pilose basally and along inner side, with a short, subapical hair; terminal appendage nearly one-fourth length of style. Paraprocts strongly curved and heavily sclerotized apically, each ending in two or three large and two or three small teeth. Phallosome bullet-shaped. Stem of harpago slender, curved, pilose basally, with one long and one shorter subapical bristle; blade not quite as long as stem, arising slightly subapically, greatly widened basally and tapered to a blunt tip. Ninth tergite with well separated lobes, each bearing four stout bristles.

Female and larva.—Unknown.

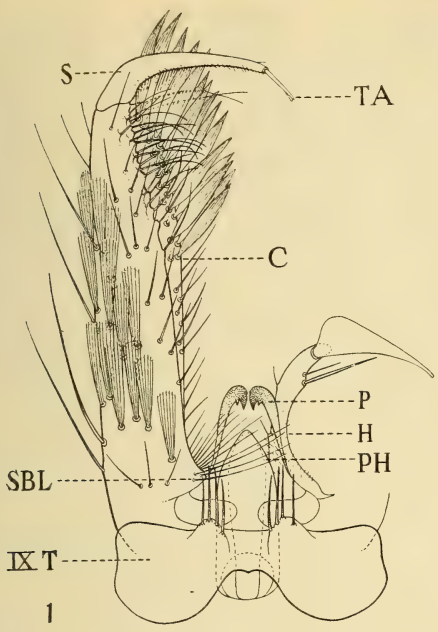
Types.—Holotype: Male (K107) reared from larva collected in a tree hole at Tsili Tsili on the Watut River (a branch of the Markham River) in the former mandated territory of eastern New Guinea, September 1943 (W. V. King collector). *Paratypes:* 2 males (one in very poor condition) same data as above. The holotype and one paratype are deposited in the United States National Museum.

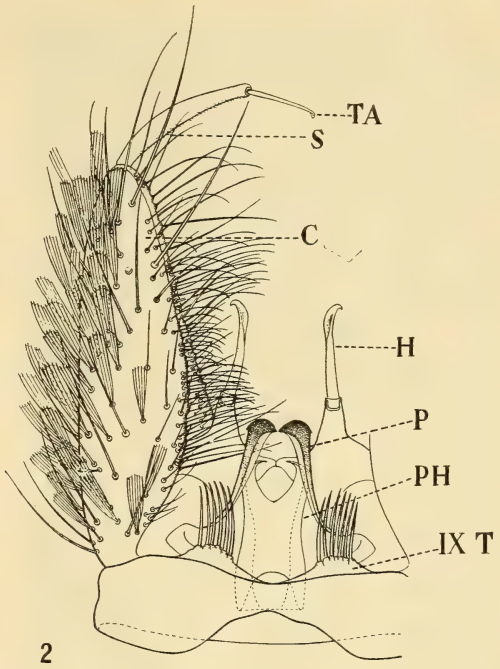
Remarks.—This species is very distinct from any other Australasian *Finlaya* but appears to be related to several Oriental species described as having a white patch on the scutum, apical and basal banding on some of the tarsal segments, and nontufted scaling of the abdominal sternites. *A.* (*F.*) *gubernatorius* (Giles) of India, the closest of these, differs in having the scales on vertex and posterior pronotum all broad, tarsal markings more extensive, male palpi all dark, coxite without modified pointed scales, etc. Other Indian species of this group (*A. assamensis* (Theobald), *A. cogilli* Edwards, etc.) have, in addition, flat scales on the scutellum. *A.* (*F.*) *seoulensis* Yamada of Korea (also known from Peiping, China) has narrow scales on the posterior pronotum and scutellum, as in *tsiliensis*, but differs (according to available description) in having broad scales on most of the head vertex, and apical and basal banding on the second as well as the first segment of the hind tarsi and the first segment of the fore tarsi. In the male the blade of the harpago is slender for entire length and the coxite lacks the patch of pointed scales.

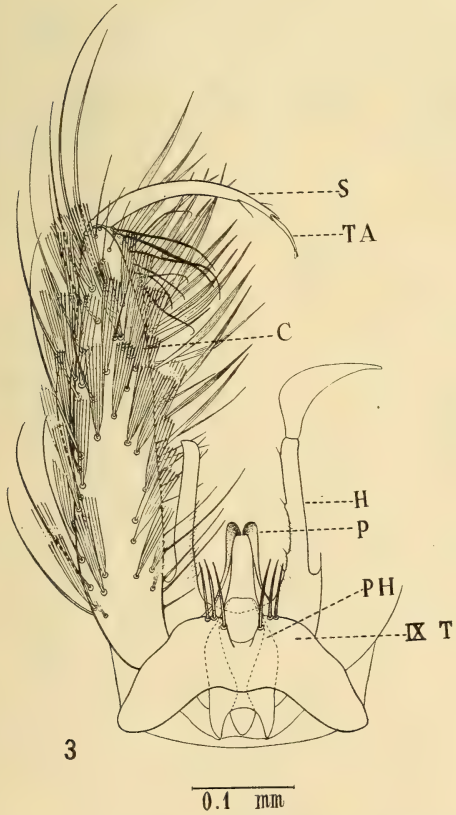
Aedes (Finlaya) plumiferus, n. sp.

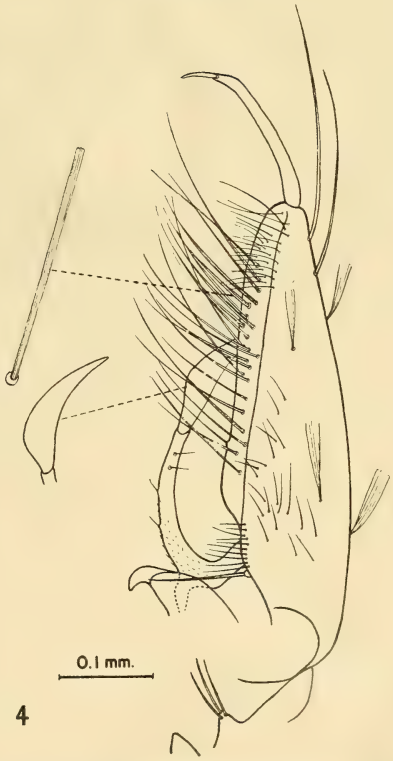
This species (Fig. 6) is immediately recognizable in the known Australasian fauna by the large tufts of scales on the abdominal sternites. The scutum has a large anterior patch of silvery-white scales, and the first segment of the mid and hind tarsi have apical as well as basal white rings.

Male.—Head: Proboscis about equal to fore femur, black; palpus all black, slightly









FIGS. 1–4.—Male genitalia: 1, *Aedes tsiliensis;* 2, *A. plumiferus;* 3, *A. quasirubrithorax;* 4. *A. keefei.*

shorter than proboscis, the apical segment about two-thirds as long as preapical, slightly turned downward; scattered long bristles from two apical segments; antenna densely plumose, the long hairs mostly in two planes. Vertex completely covered with broad appressed silvery-white scales, and pale upright scales posteriorly; a few black bristles along eye margin. *Thorax:* Front third to half of scutum (including all of fossae) covered with coarse silvery-white scales, continued posteriorly as a median line that forks around antescutellar space; a large transverse patch of white scales anterior to wing root separated from the anterior white by a stripe of fine black scales of about equal width. Mid lobe of scutellum with a median patch of lanceolate white scales, a few similar scales on the side lobes. Anterior pronotal lobe with broad white scales and long dark bristles. Posterior pronotum with a central patch of broad white scales; three or four dark bristles on posterior border. About four pale postspiracular bristles. Large dense patches of broad silvery-white scales on upper and lower sternopleuron, an elongate patch on upper mesepimeron, a small patch in front of prealar bristles, and a stripe on paratergite. Propleuron with broad white scales and about five bristles. Fore and mid coxae with small patches of white scales anteriorly. Trochanters pale, followed by a black ring at base of all femora. Fore femur all dark except for a broad ventral stripe on most of basal half and a few pale scales at apex; mid femur dark above, mostly white on lower and posterior surfaces except for a broad dark subapical band; hind femur all white except for the basal ring and a broad black ring on subapical third, longer above than below. Fore tibia with a pale stripe beneath and an apical white spot above; mid and hind tibiae all dark except for apical (or slightly preapical) white spots (incomplete rings). Fore tarsus all dark; mid tarsus with basal and apical white rings on segment 1 and a basal ring on 2; hind tarsus with a small spot at base of segment 1 and comparatively broad white rings at apex of 1 and base of 2. Fore and mid tarsal claws unequal, the larger toothed. Wing 2.7 mm., dark except for a few white scales at base of costa; lateral scales of veins 2 to 4 long and linear; first fork cell a little longer than its stem; cross veins well separated. *Abdomen:* Strongly compressed laterally, the tergites black, segments 3–6 with faint basal bands of dusky scales (probably discolored), joined to slightly enlarged lateral spots (a male paratype shows complete basal segmental white bands); a few slightly raised scales on posterior border of the dorsal median ridge of the last few segments; pale bristles on posterior and lateral borders of segments. Sternites 3–7 with large prominent tufts of erect black scales, the anterior ones on each segment long and narrow, the others decreasing in length posteriorly; a small spot of white scales at base of sternites, the rest of the recumbent scales dark. *Hypopygium* (Fig. 2, from a paratype): Coxite (C) narrowly conical, 3.5 times as long as mid width, the outer surfaces densely scaled and with scattered long bristles; inner margin with numerous long fine hairs along the middle third; margin of upper fold toward base with a double line of fine bristles, longest basally; basal lobe lacking. Style (S) slightly curved, not quite half as long as coxite, pilose on inner side; terminal appendage (TA) about half as long as style, with a small groove at tip. Harpago (H) with a short stem; blade about three times as long, slender, slightly expanded toward tip (not flattened in mount). Paraproct dark, beak-shaped at tip, with a subapical tooth. Phallosome broad, truncate apically. Lobes of ninth tergite produced, with six bristles on one side, seven on the other.

Female.—Differs from male as follows: Palpus about one-fifth length of proboscis; scales of head vertex all dark except for a median double line of broad white scales, slightly wider in front and ending in a small patch of narrow white scales between the eyes (median white not visible on paratypes); margin of eyes with a line of white scales, the front row of narrow ones, the back row of broad ones. Anterior white patch on scutum covering less than half of fossae. (Median area of scutum, except for the anterior one-fifth, denuded; in paratype females the white patch extends about level with scutal angle, indented behind, and a few white scales in front of and around antescutellar space.) Scutellum denuded (paratypes have a median line of narrow white scales, bordered by broader dark ones on mid lobe, and mixed narrow and semibroad dark scales on side lobes); wing length 3.4 mm; first fork cell about half again longer than its stem; fore and

mid tarsal claws equal, toothed; abdominal tergites with small basal lateral spots of silvery white scales on segments II to VII; VIII very small, nearly all white, the sternite large; cerci short and broad, partly retracted.

Larva (only one damaged skin available).—Antenna rather short (length 0.25 mm), glabrous, a single fine hair arising at apical fourth and reaching beyond tip of shaft; at apex, a long and a short hair and a short spine about equal in length to the apical appendage. Preclypeal spines about two-fifths length of antenna, rather stout, straight. Head hair A unusually small with four fine branches, arising behind antennal base; B single, rather short (slightly longer than antenna), arising well inside of and about level with base of antenna; C a long single hair well back of B at about middle of head; *d* minute, about 5-branched, inside of and slightly behind B. Mentum with seven stout teeth on each side of a large median tooth. Lateral hairs of abdominal segments strong, the upper one on segment I with four branches, the lower bifid, the hair on II trifid, on III–VI bifid; submedian hairs with three rather fine branches, nonplumose, the bases not surrounded by sclerotized plates. Comb of 8th segment a patch of about 35 scales, each apically rounded and fringed apically and laterally. Siphon stout, length 0.65 mm, index about 2:1; pecten of about 20 teeth extending a little beyond middle of tube, each tooth with a single stout median or sub-median denticle, and a fine fringe between denticle and base; hair tuft of five branches opposite the last pecten tooth. Anal saddle not completely encircling the segment, the posterior border with rather long spines; dorsal subcaudal hair of four equal branches; one pair of slender gills visible, a little longer than saddle.

Types.—Holotype: Male (344), reared from larva collected in buttress hole of a large rainforest tree about 250 feet elevation, Hollandia, Netherlands New Guinea, November 21, 1944 (W. T. Nailon). *Allotype:* Female (344), same data. *Paratypes:* Two males, 3 females and 1 larval skin as follows: 1 male (terminalia mount only) and 1 larval skin in poor condition (No. 1985, 220th M. S. U.), from tree hole, Hollandia, New Guinea, 1945; 1 male, 3 females (No. 166 and 165, respectively, Univ. of Queensland), "resting in treehole in shade," Lae, eastern New Guinea, August 1944 (Cpl. F. J. Armbrust). Holotype and allotype deposited in U. S. National Museum. Paratypes from Lae (which were examined through the

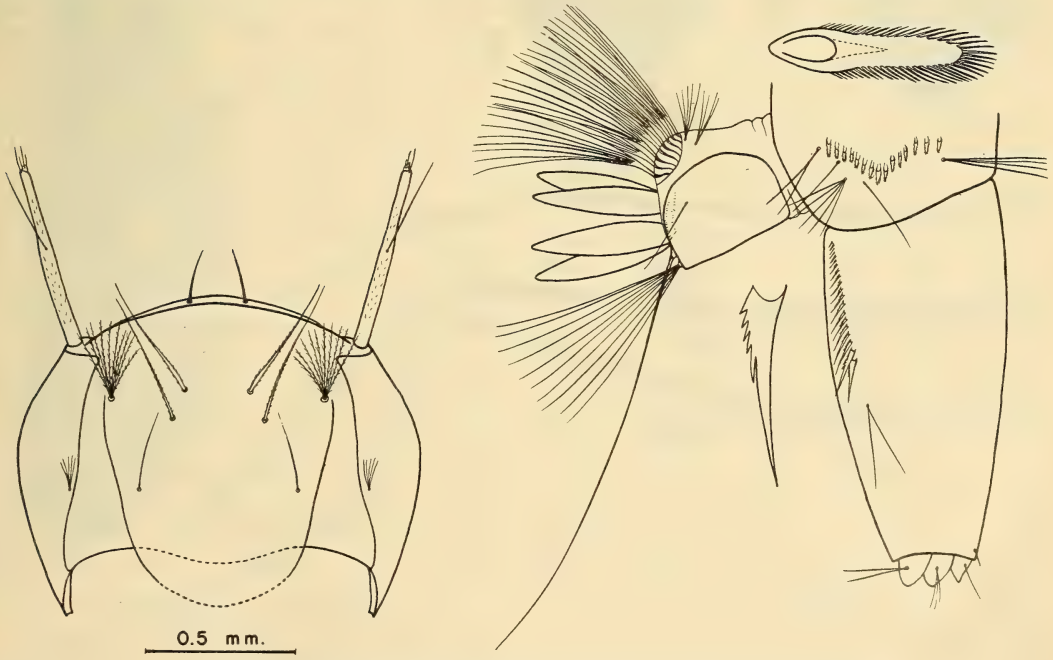


FIG. 5.—Head and terminal appendages of larva of *Aedes keefei.*

kindness of Miss E. L. Marks) are to be returned to the University of Queensland. Two additional females (Lot 226) are at hand but their markings are badly discolored from wetting with the mounting medium. These were reared from larvae from a tree hole near lot 344 October 27, 1944 (H. Hoogstraal and J. Toffaleti).

Remarks.—The larvae in Lots 226 and 344 were associated with those of *Aedes* (*Finlaya*) *notoscriptus* (Skuse), *A.* (*Stegomyia*) *albolineatus* (Theobald), and *Megarhinus splendens* (Wiedemann).

A. plumiferus belongs to a small sub-group of Oriental species having tufts of long scales on the abdominal sternites, both apical and

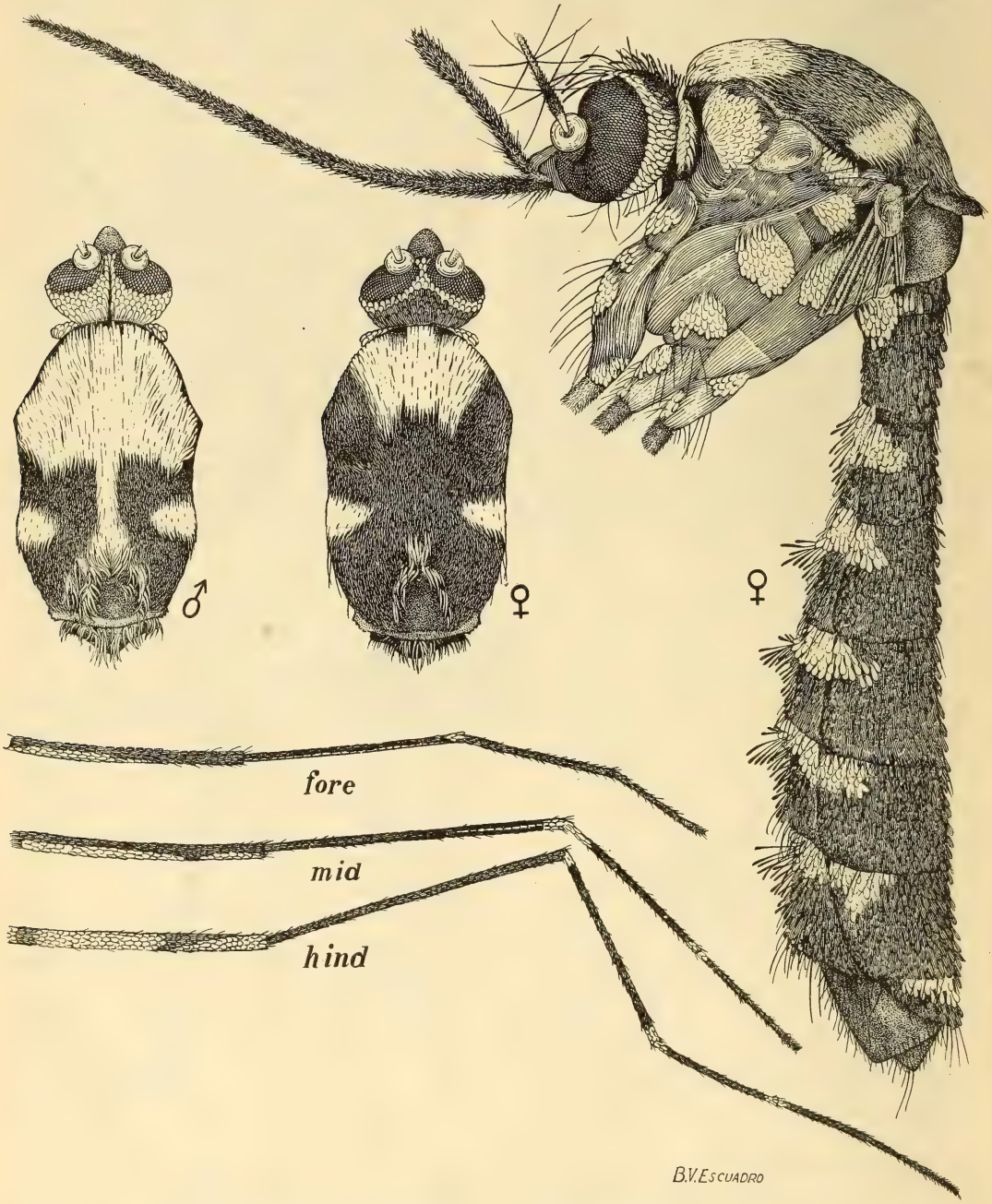


Fig. 6.—Ornamentation of adults of *Aedes plumiferus*.

basal white rings on the first tarsal segment of the mid and hind legs and a large patch of white on the scutum. These species include *A. prominens* (Barraud) and *A. khazani* Edwards of India, *A. melanopterus* Giles of the Philippines, and *A. watasei* Yamada of Japan. It differs from the first two in having narrow scales on the scutellum, only white scales on the head in the male and a median white strip on the head in the female. The posterior pronotum is also bare of scales in *prominens*. *A. watasei* (of which only the female has been described) differs in having tufts of long scales on tergites 5–7 similar to those on the sternites, broad basal segmented white bands on the venter and flat scales on the scutellum. From a comparison with specimens of *A. melanopterus* recently obtained in the Philippines, *plumiferus* is found to be very similar, although the larva is distinct. In the male of *melanopterus* the palpi seem to be somewhat shorter, failing to reach the base of the labella, the blade of the harpago is more distinctly widened at the apical third, the lobes of the ninth tergite have four bristles each instead of six or seven, the base of the style is swollen and the bristles near the base of the coxite form more of a patch. The principal difference between the larvae is in the submedian hairs of the abdominal segments. In *melanopterus* (two specimens of which were examined through the kindness of Dr. K. L. Knight) these hairs are branched from two to six times and are unusually long and stout, sparsely plumose and have a small sclerotized plate around the basal papilla. In *plumiferus* the hairs are less than half as long, 3-branched, nonplumose, and not arising from a plate. A typical hair on segment 5 measured 0.22 mm, compared with 0.48 mm for a hair on the same segment of *melanopterus*. Other minor differences were noted as follows: preclypeal spines in *melanopterus* somewhat stouter and distinctly curved, saddle hair double instead of single, dorsal subcaudal hair of anal segment of six branches instead of four, and spines on posterior border of saddle about twice as long, especially toward the lower corner.

Aedes (Finlaya) keefei, n. sp.

This species is somewhat above medium size and has an ornamented scutum consisting of faint median and submedian golden lines and wider lateral curved lines. The hind tarsal segments have broad basal bands and segment 5 is entirely white. It is closely related to the Australian species *A.* (*F.*) *quasirubrithorax* (Theobald).

Female.—Head: Proboscis dark-scaled, about equal in length to fore femur. Palpus dark-scaled, one-sixth as long as proboscis. Torus tan. Clypeus black, nude. Vertex with scattered lanceolate silvery scales, a denser border along eyes, and numerous dark upright forked scales; lateral surface with broad silvery-white scales. *Thorax:* Scutum and pleura with yellowish-brown integument; scutum covered with fine dark-brown scales, three small patches of white scales with yellowish tinge on anterior border; faint median and submedian lines each represented by a single broken line of silvery scales reaching the middle of scutum; laterally with a narrow line of white scales extending from the anterior margin to the scutal angle, there broadening around the posterior border of the fossa and then continuing as a narrow line nearly to the scutellum; a few narrow pale scales over the wing bases. Scutellum densely clothed with silvery white scales, broad appressed ones on mid lobe, long lanceolate ones on side lobes, narrowest at outer side. Postnotum yellowish, nude. Anterior pronotal lobe with lanceolate white scales with yellowish tinge, and with dark bristles. Posterior pronotal lobe with black, moderately broad, spatulate, appressed scales on upper two-thirds, somewhat narrower ones on upper margin and a few broad pale scales low down; six dark bristles along posterior margin. Paratergite with broad white scales. About eight postspiracular bristles. Sternopleuron with a patch of broad white scales on upper half, another on lower posterior border; long bristles along upper and posterior margins. A small patch of white scales at base of prealar knob. Mesepimeron with a patch of broad white scales on anterior half extending from upper margin to lower third; yellowish bristles above the white patch. Propleuron with broad white scales and a group of about 14 long pale bristles. Wing length: 3.8 mm. All scales dark; lateral scales of veins 2 to 4 long and narrow, those on the tips slightly broader and shorter; anterior fork cell amost one and a half times as long as its base, arising about level with posterior fork cell; posterior cross vein more basal

than mid by at least twice its own length. Haltere entirely yellow. Coxae with pale scales, a patch of dark ones on anterior surface of fore coxa. Fore and mid femora each with a broad line of pale yellowish scales on inner surface for about half its length; basal two thirds of both inner and outer surface of hind leg pale yellow; knee spots silvery white on all legs. Tibiae completely dark. Fore and mid tarsi with distinct white basal rings on segments 1 and 2, and a small spot on 3; hind tarsus with broad white rings on segments 1–4, that on 4 about two-fifths length of segment, segment 5 entirely white; fore and mid tarsal claws about equal and toothed. Tergites dark-scaled with metallic reflection, narrow median basal pale spots on III to VI almost connected with lateral spots; large silvery white basal lateral spots on II to VII, becoming gradually larger on the apical segments, extending full length of segment and onto dorsum; sternites broadly pale-scaled basally, with narrow posterior dark bands; eighth sternite compressed laterally, small, scaleless; cerci broad, partly retractly.

Male.—Differs from female as follows: Palpus about equal in length to proboscis, the two apical segments turned downward; a ventrally directed row of long bristles from tip of long segment and basal portion of subapical segment, sparse short bristles on remainder of the two apical segments; white basal spots on the two apical segments, about one-third their length, and a white ring in the middle of long segment; antenna densely plumose, the long hairs arranged mostly in two planes; first fork cell about a third longer than its petiole; abdominal tergites III-V with complete, rather wide, white basal bands, a narrow one on VI. *Hypopygium* (Fig. 4): Coxite long (0.45 mm) and slender, nearly four times as long as mid width, heavily scaled on outer surfaces, inner fold extending to tip; basal lobe lacking, represented by a small patch of bristles, the basal one of which is much longer than the others; apical half of the margin of lower fold with a dense line of long bristles, slightly modified, their stems showing one or two striations; above these on both the upper and lower folds, several rows of long very fine hairs. Style very slender, slightly more than a third as long as coxite; terminal appendage about one-fourth as long as style. Harpago with a long slender stem (reaching about to middle of coxite), its basal half sparsely pilose; blade slightly shorter than stem, much widened near base, curved and tapered to a slender tip. Paraproct with a black, beak-like tip and a small subapical tooth. Phallosome broad, simple. Lobes of ninth tergite produced, each with three bristles.

Larva (Fig. 5).—Head about 0.8 mm long, half again as wide; antenna long and slender, about two-thirds as long as head, spiculate, a single hair from middle of shaft, reaching beyond tip of shaft; two long and two short apical bristles and a finger-like appendage. Preclypeal spines long and slender. Head hair A a large tuft of about 10 branches, B and C long and single, B about level with base of antenna, C slightly ahead and inside of B, *d* a multiple tuft of rather long hairs between the bases of B; *e* single or forked at middle, *f* with about 7 branches. Anterior submedian prothoracic hairs 1 to 3 set on a plate, No. 1 a short tuft of about six branches, 2 long, single, 3 long, bifid. Upper lateral hair of abdominal segment I with five or six branches, the lower with four; lateral hair on II 3-branched, on III to V double; submedian hairs long, double. Comb of eighth segment a long, even, curved row of about 18 teeth, each rounded and evenly fringed. Air tube short and stout, index about 2:1 (length 1.2 mm); acus present; pecten of about 20 closely set teeth on basal half of tube, the individual tooth long, sharp, with 5–7 denticles on one side of the widened basal half, the teeth progressively longer toward tip of pecten; tuft of two or three branches beyond pecten. Anal saddle covering a little more than half of segment, spiculate on posterior border; lateral hair single; one or two small tufts in front of ventral grid; dorsal subcaudal tuft with about ten branches, the ventral subcaudal hair single as usual. Anal gills small, slightly longer than the saddle.

Types.—Holotype: Female (K 128B-3) reared from larva collected in a stump hole near K. B. Mission, Milne Bay, Papua, New Guinea, October 1943 (Chaplain A. M. Keefe collector). *Allotype:* Male from same lot. *Paratypes:* 1 male, 8 females (with several larvae and pupal skins and whole larvae) as follows: 2 females (K 128B-3), same data as holotype; 1 male (H-1-1) seven females (H-313-1, H-1-5, H-1-2, H-1-10, H-1-7), "Hilimoi, Milne Bay, Papua, N. G. Penn & Bick" (probably late 1943); 1 female (46 B) "Sariba Is. N. G. 1-10-44. T. K.

Ruebush" (probably in Milne Bay area). Holotype and allotype deposited in U. S. National Museum. The paratypes from Hilimoi and Sariba Islands were examined in the collection of this museum. One paratype from lot K 128B-3 to be deposited in the museum of the Division of Economic Entomology, Council for Scientific and Industrial Research, Canberra, A. C. T., Australia.

Remarks.—This species is very similar in general appearance to *A.* (*F.*) *quasirubrithorax* (Theobald) but differs distinctly in having broad (instead of narrow) scales on the mid lobe of the scutellum, and small, flat, black scales (instead of narrow yellowish ones) on the upper half of the posterior pronotum. The scutal pattern is also less distinct. In this respect most of the New Guinea specimens of *quasirubithorax* that have been examined have a less distinct pattern than specimens from Australia but seem otherwise to be very similar. In the male genitalia of *quasirubrithorax* (Fig. 3, from a Hollandia, New Guinea specimen) most of the modified scales on the inner margin of the lower fold of the coxite are distinctly broader than those in *keefei* and the wider ones show three or four striations.

From the original collection at Milne Bay (K 128B-3), seven adults were reared by the senior author from larvae that were thought to represent a single species. The adults were found to consist of one male, three females of a new species, and two males, one female of *quasirubrithorax*. The larvae had not been individually isolated but all the skins were saved. A tentative association of the larvae of the two species was made on the basis of the number of each (four of one and three of the other). This association was later confirmed by larvae in the U. S. National Museum associated with a collection of adults of the new species from Hilimoi, Milne Bay. The larval material consisted of several whole larvae and three larval skins, at least two of which appeared to be associated by subnumbers ("1:7" and "1:10") with individual adults. In the Museum collection there was found also a series of adults and larvae of *quasirubrithorax* bearing Roberts lot numbers and likewise collected in the Milne Bay area. While the larvae of the two species are very similar, two slight differences in hair branching, which appeared to be constant, were noted. In *quasirubrithorax* head hair B was double or sometimes triple on each of fourteen larvae examined (including those in lot K 128B), and hair 3 of the submedian prothoracic group was single on each; in *keefei* head hair B was single on at least one side, usually on both sides, on nine specimens, while prothoracic hair 3 was usually double. In specimens of both species the airtube is distinctly shorter in comparison to the diameter (index about 2:1) than that shown for Australian *quasirubrithorax* by Lee (*Atlas of mosquito larvae of the Australasian Region*, 1944, p. 62), in which the index is 3:1 or more. The comb scales are also apically fringed instead of bare as illustrated by this author.

A. quasirubrithorax has not previously been reported from New Guinea. In addition to the Milne Bay records, we have three females and a male (lots 811 and 848) reared from larvae collected in tree holes in March 1945 by members of the 19th Medical General Laboratory in the Hollandia area of northern Netherlands New Guinea, and one female from the island of Kiriwina (east of New Guinea) collected in August 1943 by the 5th Malaria Survey Unit.

We have also a female (Lot 796) collected while biting on Mount Defonsero in the Cyclops Range, Hollandia area, in March 1945 (W. R. Fullem and H. Cook collectors), which differs from both the previously mentioned species in having broad white scales on all lobes of the scutellum. The specimen is so badly denuded and broken, however, that its relationship can not be determined.

ENTOMOLOGY.—*Notes on some Ashmeadian genotypes in the hymenopterous superfamily Chalcidoidea.*[1] A. B. GAHAN, U. S. Bureau of Entomology and Plant Quarantine, and O. PECK, Division of Entomology, Department of Agriculture of Canada. (Communicated by C. F. W. MUESEBECK.)

In Ashmead's monograph of the Chalcidoidea (Mem. Carnegie Mus. **1**: 225–551. 1904) a number of new genera are proposed with the designation of a genotype for each. Many of these genotypes were manuscript species for which the only characterizations given in the work were the descriptions in the generic keys. Type localities were indicated for none of those species. In a few instances a species was cited as the genotype of a particular genus on one page and a different genotype listed for the same genus on another page. In one instance a typographical error resulted in a name entirely different from that which the author obviously intended. Several of these Ashmead genera and species have been redescribed by Girault as new under the same or different generic and specific names. A few have been treated by other authors. These subsequent references are scattered and not always easily traced.

The object of this paper is to list these genotypes together with their type localities and pertinent citations to subsequent literature and to clear up, so far as possible, the confusion regarding some of the species involved. Fortunately we have been able to consult not only the types in the United States National Museum but also those from the Carnegie Museum in Pittsburgh, the two collections comprising practically all the material that formed the basis of Ashmead's monumental work.

In the second part of the monograph (pp. 394–551) a number of the new genera and their genotypes are more fully described. These species have not been included in the following list unless supplemental data of interest needed to be added. Likewise excluded from the list are those genotypes of which descriptions had been published prior to publication of the monograph.

[1] Received July 3, 1946.

Alloderma maculipennis Ashmead: 273, 365.[2] Type in U. S. National Museum, from Sydney, New South Wales, Australia. Ashmead's type redescribed as *Coelocybelloides bioculatus* Girault (Mem. Queensland Mus. **5**: 224. 1916).

Alophus flavus Ashmead: 353, 365, 520. Type in collection of Carnegie Museum, from Chapada, Brazil. On pages 353 and 365 Ashmead cites *A. flavus* as type of the genus, but on page 520, following the description of the genus, he includes only one species, viz., "*Alophus brasiliensis* sp. n." There are no specimens in the U. S. National Museum collection and none in the Carnegie Museum collection labeled *A. flavus* Ashmead, and apparently there is no description of an *A. flavus* in the literature other than that in the generic key on page 353 cited above. It seems apparent that the specific names *flavus* and *brasiliensis* both refer to specimens in the Carnegie Museum collection labeled *Alophus brasiliensis*. Since *flavus* has page precedence, and since that name has been cited as the genotype by Ashmead, and later by Gahan and Fagan in their genotype catalog of chalcidoid genera (U. S. Nat. Mus. Bull. **124**: 10. 1923), we shall retain the name *flavus* for the species and consider *brasiliensis* a synonym. *Alophus* preoccupied, replaced by *Alophomyia* Ashmead (Proc. Ent. Soc. Washington **6**: 126. 1904).

Aphobetoideus comperei Ashmead: 328, 366. Type in U. S. National Museum, from Swan River, New South Wales, Australia. Species redescribed by Smith and Compere (Univ. California Publ. Ent. **4**: 312. 1928).

Aximogastra bahiae Ashmead: 261, 367, 463. Type in U. S. National Museum, from Bahía, Brazil.

Aximopsis morio Ashmead: 259, 460; pl. 22, fig. 6. Type in collection of Carnegie Museum,

[2] The numbers cited following the specific names refer to pages in the Mem. Carnegie Mus. 1, 1904.

from Santarém, Brazil. On page 367 Ashmead indicates *A. bahiae* Ashmead as the genotype, but this is evidently a confusion with *Aximogastra* Ashmead, of which *A. bahiae* is the type.

Blatticida pulchra Ashmead: 305, 368. Type in U. S. National Museum, from Mulgoa, New South Wales, Australia. Reared in December 1891 from roach eggs on orange leaves by A. Koebele.

Brachycaudonia californica Ashmead: 283, 368. Type in U. S. National Museum, from Los Angeles County, Calif.

Bruchobius laticeps Ashmead: xi, 314. Type in U. S. National Museum, from Washington, D. C. Species redescribed by Crawford (Proc. U. S. Nat. Mus. **45**: 250. 1913).

Cecidoxenus nigrocyaneus Ashmead: 274, 369. Type in U. S. National Museum, from Flemington, New South Wales, Australia. Ashmead's types redescribed as *Parachryomalla secunda* Girault (Insecutor Inscitiae Menstruus **5**: 154. 1917).

Ceratosmicra petiolata Ashmead: 251, 369. Type in U. S. National Museum, from Chapada, Brazil. Specific name preoccupied by (*Smicra*) *Ceratosmicra petiolata* (Cresson) and *lissa* proposed to replace it by Burks (Proc. U. S. Nat. Mus. **88**: 343. 1940).

Chrysoatomus zealandicus Ashmead: 342, 370. Type in U. S. National Museum, from Swan River, Australia.

Decatomothorax gallicola Ashmead: 273, 372. Type in U. S. National Museum, from New South Wales, Australia.

Diaulus begini Ashmead: 356, 372. Type in U. S. National Museum, probably from Sherbrooke, Quebec Province, Canada, and collected by Abbé Begin. Generic name preoccupied, replaced by *Diaulinus* Schulz (Spolia Hym., p. 146. 1906). Genus discussed and species redescribed by Crawford (Proc. U. S. Nat. Mus. **43**: 183. 1912). *Diaulinus* a synonym of *Solenotus* Foerster, according to Girault (Indications in new insects . . . p. 3. 1925. Private publ.).

Eisenia mexicana Ashmead: 233, 373. Type in U. S. National Museum, from San Blas, Tepic, Mexico. Generic name preoccupied, replaced by *Secundeisenia* Schulz (Spolia Hym., p. 146, 1906).

Encyrtaspis brasiliensis Ashmead: 290, 373, 492. Type in U. S. National Museum, from Pernambuco, Brazil. Genus and species more fully described by Gahan (Proc. U. S. Nat. Mus. **71** (art. 4): 9. 1927; **94**: 363. 1943).

Epinaeoideus melanocephalus Ashmead: 374. *Nomen nudum* according to Gahan and Fagan (U. S. Nat. Mus. Bull. **124**: 55. 1923).

Epipteromalus algonquinensis Ashmead: 319, 374. Type in U. S. National Museum, from Algonquin, Ill. Ashmead's types redescribed as *Polycystus gibbus* Girault (Proc. U. S. Nat. Mus. **58**: 212. 1920). *Epipteromalus* considered a synonym of *Trichomalus* Thomson by Kurdjumov (Rev. Russ. Ent. **13**: 4. 1913).

Euophthalmomyia pallidipes Ashmead: 339, 375. Type in U. S. National Museum, from Washington, D. C.

Eutrichosoma mirabile Ashmead: 291, 375. Type in U. S. National Museum, from Helena, Mont.

Froggattia polita Ashmead: 238, 375. Type in U. S. National Museum, from Sydney, New South Wales, Australia. Generic name preoccupied, replaced by *Eufroggattia* Ashmead (Proc. Ent. Soc. Washington **6**: 126. 1904).

Hubbardiella arizonensis Ashmead: 339, 378. Type in U. S. National Museum, from Chiricahua Mountains, Ariz. Genus and species redescribed from Ashmead types as *Miromphalomyia perilampoides* Girault (Entomologist **49**: 249. 1916).

Koebelea australiensis Ashmead: 238, 378. Type in U. S. National Museum, from Sydney, New South Wales, Australia. Generic name preoccupied, replaced by *Eukoebelea* Ashmead (Proc. Ent. Soc. Washington **6**: 126. 1904).

Melanosmicra immaculata Ashmead: 251, 448. Type in collection of Carnegie Museum from Chapada, Brazil. Genus declared a synonym of *Ceratosmicra* by Burks (Proc. U. S. Nat. Mus. **88**: 343. 1940).

Mirocerus psyllae (=*peyelae*, typographical error) Ashmead: 309. Type in U. S. National Museum, from Peradeniya, Ceylon. The type specimen is plainly labeled *psyllae* and was bred from a psyllid by E. E. Green.

Mischosmicra kahlii Ashmead: 251, 381. Type in U. S. National Museum, from Lawrence, Kans. Synonym of *Ceratosmicra debilis* Say, according to Burks (Proc. U. S. Nat. Mus. **88**: 345. 1940).

Mormoniella brevicornis Ashmead: 316, 382. Type in U. S. National Museum, from Algonquin, Ill. Genotype based on same specimens as *Nasonia brevicornis* Ashmead, genotype of *Nasonia* Ashmead, according to Brues (Can. Ent. **42**: 260. 1910). Synonym of *Mormoniella vitripennis* (Walker), according to Gahan (Proc. U. S. Nat. Mus. **71** (art. 4): 5. 1927).

Nasonia brevicornis Ashmead: 317. See under *Mormoniella brevicornis* Ashmead.

Nesomyia albipes Ashmead: 344, 382. Type in U. S. National Museum, from Atami, Japan. Species redescribed as new by Ashmead (Journ. New York Ent. Soc. **12**: 161. 1904).

Notanisomorpha collaris Ashmead: 356, 382. Type in U. S. National Museum, from Cedar Point, Md. Genus and species redescribed by Crawford (Proc. U. S. Nat. Mus. **43**: 185. 1912).

Octosmicra laticeps Ashmead: 252, 382. No type specimens have been located, and the type locality is unknown. Five species from Brazil are listed on pages 450 and 451, but *laticeps* is not among them. Burks (Proc. U. S. Nat. Mus. **88**: 263. 1940) synonymized the genus with *Spilochalcis* Thomson.

Pachycrepoideus dubius Ashmead: 239, 383. Type in U. S. National Museum, from East Lansing, Mich. Genus and species fully described by Girault and Sanders (Psyche **17**: 110. 1910).

Parapteromalus isosomatis Ashmead: 320, 384. Type in U. S. National Museum, from Urbana, Ill. Ashmead's types redescribed as *Merisus carinatus* Girault (Soc. Ent. Stuttgart **31**: 57. 1916).

Parasaphes iceryae Ashmead: 328, 384. Type in U. S. National Museum, from Columba, New South Wales, Australia. Generic name preoccupied, replaced by *Parasaphodes* Schulz (Spolia Hym., p. 146. 1906). Ashmead's types redescribed as *Amiscogaster ruskini* Girault (Insecutor Inscitiae Menstruus **5**: 144. 1917).

Paraspalangia annulipes Ashmead: 334, 384. Type in U. S. National Museum, from College Station, Tex. Ashmead's types redescribed as *Stigmatotetrastichus emersoni* Girault (Ann. Ent. Soc. Amer. **9**: 304. 1916).

Paraterobia nigriceps Ashmead: 284. Type in U. S. National Museum, from Tumut, New South Wales, Australia. Ashmead types redescribed as part of the type series of *Perilampoides aurantiscutum* Girault (Mem. Queensland Mus. **5**: 224. 1917).

Pentasmicra brasiliensis Ashmead: 225, 384. Type in collection of Carnegie Museum, from Corumba, Brazil. Genus and species more fully described by Kahl (Ann. Carnegie Mus. **13**: 265. 1921). Genus declared a synonym of *Spilochalcis* Thomson by Burks (Proc. U. S. Nat. Mus. **88**: 264. 1940).

Pheidoloxenus wheeleri Ashmead: 328, 385. Type in U. S. National Museum, from Texas. Species figured and redescribed by Wheeler (Bull. Amer. Mus. Nat. Hist. **23**: 17. 1907). Ashmead types redescribed as new under the same generic and specific names by Girault (Ann. Ent. Soc. Amer. **8**: 273. 1915).

Pristosmicra sexmaculata Ashmead: 386. Neither genus nor species described, and apparently no type specimens exist. Name is a *nomen nudum.*

Schwarzella arizonensis Ashmead: 256, 388. Type in U. S. National Museum, from Arizona.

Scotolinx gallicola Ashmead: 354, 388. Type in U. S. National Museum, from Liverpool, New South Wales, Australia. Ashmead types described as new under the same generic and specific names by Girault (Mem. Queensland Mus. **5**: 218. 1916).

Scymnophagus townsendi Ashmead: 319. Types in U. S. National Museum, from San Luis and Monterey, Mexico. Genus a synonym of *Xenocrepis* Foerster, according to Kurdjumov (Rev. Russe Ent. **13**: 6. 1913). Redescribed as *Xenocrepis mexicana* Girault (Ent. News **27**: 227. 1916) with same specimens as types.

Spathopus anomalipes Ashmead: 272. Type in U. S. National Museum, from Jacksonville, Fla. Included in key to genera of Pireninae by Ferriere (Mitt. Schweiz. Ent. Ges. **16**(1): 86. 1934).

Stenomesioideus melleus Ashmead: xi, 355, 389. Type in U. S. National Museum, from Washington, D. C. Redescribed as *Stenomesioidea mellea* Girault (Proc. U. S. Nat. Mus. **51**: 43. 1916) with same specimen as type.

Stigmatocrepis americana Ashmead: 273, 389. Type in U. S. National Museum, from Jacksonville, Fla.

Stylophorella perplexa Ashmead: 275, 389. Type

in U. S. National Museum, from San Diego, Tex. Genus a synonym of *Picroscytus* Thomson, according to Crawford (Can. Ent. **41**: 98. 1909). *Picroscytus* Thomson is a synonym of *Artholysis* Foerster, according to Gahan and Fagan (U. S. Nat. Mus. Bull. **124**: 115. 1923).

Tachardiaephagus thoracicus Ashmead: 303, 390. Type in U. S. National Museum, from Ceylon. Generic and specific synonymy, references, and descriptive notes given by Ferriere (Bull. Ent. Res. **19**: 171. 1928).

Tachinaephagus zealandicus Ashmead: 304, 390. Type in U. S. National Museum, from Queanbeyan, New South Wales, Australia. Generic and specific synonymy discussed by Gahan (Proc. Ent. Soc. Washington **40**: 210. 1938).

Trichencyrtus chapadae Ashmead: 291, 392, 495. Type in collection of Carnegie Museum, from Chapada, Brazil. The type is labeled *T. robustus*, but evidently it is the specimen intended as the genotype and referred to on page 291 as *chapadae*. (See Gomes, Bol. Soc. Brasil Agronomia **5**: 287. 1942.)

Trigonogastra auratus Ashmead: 330, 392. Type in U. S. National Museum. This type bears only the label "Ac. Cat. 595A," but it is believed to have been from Lansing, Mich.

Tropidogastra arizonensis Ashmead: 323, 392. Type in U. S. National Museum, from Santa Rita Mountains, Ariz. Type redescribed as *Dinarmus arizonicus* Girault (Insecutor Inscitiae Menstruus **4**: 109. 1916). Genus synonymized with *Cheiropachus* Westwood by Gahan (Proc. Ent. Soc. Washington **40**: 220. 1938).

Uroderostenus pleuralis Ashmead: 343, 392, 511. Type lost; from St. Vincent, West Indies (H. H. Smith, collector). The type was originally deposited in the U. S. National Museum, but only the empty pin remains.

Xanthoatomus albipes Ashmead: xi, 360. Type in U. S. National Museum, from Washington, D. C. Although he published the name, Ashmead apparently never placed the name label on any specimens, but certain specimens previously standing under the generic name in the U. S. National Museum collection, as arranged by Ashmead, were without much doubt the ones to which he intended to apply the name. These specimens were remounted on slides and studied by A. A. Girault, who identified them as *Pentarthron minutum* (Riley) (Bull. Wisconsin Nat. Hist. Soc. **9**: 155. 1911), now known as *Trichogramma minutum* (Riley). Records of the Bureau of Entomology and Plant Quarantine show that these specimens were reared from eggs of *Hyphantria textor* Harris collected in the vicinity of Washington, D. C., August 18, 1883. Since these specimens are believed to be the Ashmead types and since Girault's identification appears to be correct, the genus *Xanthoatomus* Ashmead should be considered a synonym of *Trichogramma* Westwood, and the species *X. albipes* a synonym of *T. minutum* (Riley).

MAMMALOGY.—*A new Philippine rat allied to* "Bullimus" bagobus *Mearns.*[1]

DAVID H. JOHNSON. (Communicated by HERBERT FRIEDMANN.)

On the basis of a single specimen from Todaya, at 4,000 feet altitude on Mount Apo, southern Mindanao, Mearns (1905, p. 450) founded a new genus and species of rat, *Bullimus bagobus*. Thomas (1907, p. 141) recorded a second specimen from 3,000 feet altitude on the same mountain and synonymized *Bullimus* under the then broad genus *Mus*. Apparently no further specimens have been recorded. *Bullimus* has been treated subsequently as a valid genus by Hollister (1912, p. 30; 1913, p. 324) and by Taylor (1934, p. 411), and as a synonym of *Rattus* by Ellerman (1931, pp. 148, 159).

Surveys of rodents conducted in 1945 and 1946 by units of the Medical Department of the U. S. Navy in the vicinity of Guiuan, southeastern Samar Island, revealed the presence there of a closely related subspecies. The first specimen was taken at Mercedes on March 7, 1945, by Lt. Jesse E. Barker, U.S.N.R., and was added by him to a collection being made by an advance part of Naval Medical Research Unit no. 2. Subsequently Lt. (jg) Willard W. Lahnum, U.S.N.R., working in cooperation with Epidemiology Unit no. 61, collected additional specimens near Mercedes and on nearby Calicoan Island.

[1] Received July 25, 1946.

Six specimens have thus come to the United States National Museum, where they been compared with the type specimen of *bagobus*.

Rattus bagobus barkeri, n. subsp.

Type specimen.—U.S.N.M. no. 278141, young adult male, skin and skull, collected March 7, 1945, by Jesse E. Barker, prepared by D. H. Johnson, original no. 276.

Type locality.—Village of Mercedes, 5 miles north of Guiuan, southeastern Samar Island, Philippine Islands. Altitude about 200 feet. (See Fig. 1.)

Diagnosis.—Differing from *Rattus bagobus bagobus* in smaller size, sparser and less woolly pelage, predominantly gray (rather than whitish) underparts, relatively broader and more angular skull, larger audital bullae, narrower interbullar space, and smaller molar teeth.

Characters.—Size large; tail shorter than head and body; males larger than females (see Table 1). Ears large, rounded, and leathery, practically naked on both surfaces. Scales near base of tail in 9 annular rows per centimeter. Hind foot broad, sole bare to heel, tarsal part elongate, toes relatively short and stubby.

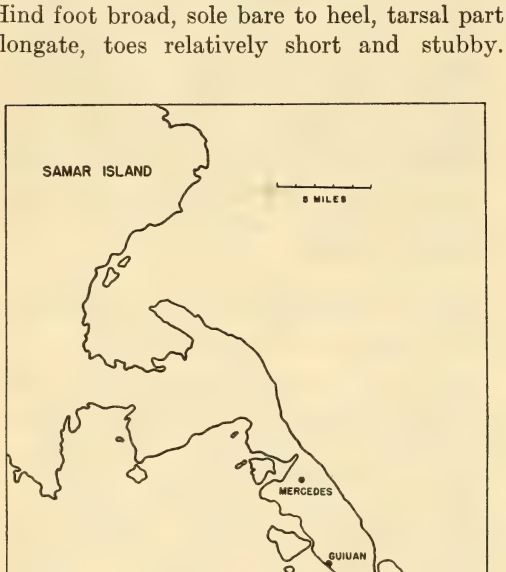


FIG. 1.—Map of the southeastern part of Samar Island, showing localities mentioned in the text.

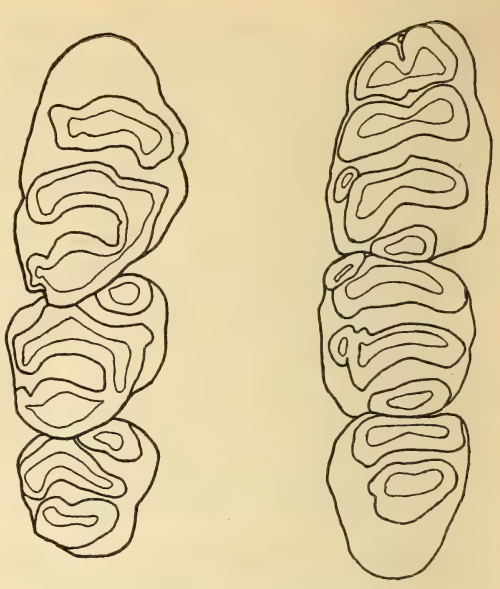


FIG. 2.—Occlusal surfaces of (*A*) right upper and (*B*) left lower molar teeth of *Rattus bagobus barkeri*, n. subsp., type specimen. ×6.

Mammary formula (in type of *bagobus* and three females of *barkeri*) 1–3 = 8.

Color of type specimen (capitalized color terms are from Ridgway, 1912): Upperparts in general Bister, in detail a mixture of black and Sayal Brown; sides paler than back, with Pinkish Cinnamon to Cinnamon hair tips underlain by Neutral Gray basal color; underparts Drab (mottled on throat and chest with Army Brown patches, which are thought to be adventitious stains); chin whitish; tail black above and below and completely to the tip (with considerable reddish-brown discoloration from the predominating coral clay of the region); feet blackish with a sprinkling of short silvery hairs; vibrissae black, extending back beyond ear. Old adult specimens are darker, near Vandyke Brown or Bone Brown on the midback; the underparts in no. 282149 are unusually pale, the hairs silvery to the base, with a variable reddish tinge resulting at least in part from adventitious staining; in no. 282146 the terminal 18 mm of the tail is yellowish white.

Skull with elongate rostrum and prolonged frontal region; nasals ending anterior to level of lacrymal processes; temporal ridges well developed, with pronounced angle at fronto-

parietal suture; incisive foramina ending anterior to root of M^1; palate narrow, ending opposite posterior edge of M^3; greatest zygomatic breadth opposite frontoparietal suture; bullae large and inflated, each with a dentlike depression on its outer side; molar pattern essentially as in type specimen of *bagobus:* upper molars with outer row of cusps reduced; no outer cusps on first lamina of M^2 and M^3; external accessory cusps anterior to third lamina of M_1 and first and second laminae of M_2 (Fig. 2).

Measurements.—See Table 1.

Distribution.—Known only from the extreme southeastern peninsula of Samar Island and from adjacent Calicoan Island (Fig. 1).

Remarks.—Other rats trapped in the vicinity of Guiuan were *Rattus everetti*, *R. mindanensis*, and a member of the *Rattus exulans* group; these were abundant in the casually cultivated coconut-grove and yam-patch association that characterizes the low-lying inhabited parts of the area. In contrast, *Rattus bagobus* seemed to prefer the vicinity of the native jungle, most of which was confined to the elevated coral ridges. The type specimen was taken at a place where the two associations meet, and according to information supplied by Lieutenant Lahnum, his specimens were all taken in the high forested country.

This species seems to be a specialized member of the *Rattus xanthurus* group, which is limited geographically to Celebes and the Philippine Islands. Other Philippine species of the group (see Ellerman, 1941, p. 190) are *albigularis*, *everetti*, *gala*, *luzonicus*, and *tagulayensis;* with these I should also place *Rattus tyrannus* Miller of Ticao Island, which has been erroneously assigned to the *Rattus norvegicus* group by Taylor (1934, p. 427) and Ellerman (1941, p. 184). All these species are represented in the U. S. National Museum, either by types or by referred specimens. From all of them *Rattus bagobus* differs in its usually unicolored tail and its elongate rostrum. The nearest relative seems to be *Rattus luzonicus* from Mount Data, Luzon, but the latter has much smaller bullae and

TABLE 1.—MEASUREMENTS IN MILLIMETERS OF SPECIMENS OF THE TWO SUBSPECIES OF RATTUS BAGOBUS

Specimen and locality	Head and body	Tail	Hind foot	Ear, from notch	Condylobasal length	Length of nasals	Zygomatic breadth	Interorbital breadth	Depth of rostrum	Length of incisive foramina	Length of auditory bullae	Length of upper molar row	Length of lower molar row
No. 278141 (♂) Mercedes, Samar *barkeri*, type	236	187	53	28	54.1	23.1	26.8	7.6	10.7	9.9	10.7	9.1	9.4
No. 282149 (♂) Mercedes, Samar *barkeri*	267	178	51	—	57.4	24.4	—	7.5	11.0	11.3	10.4	9.1	9.5
No. 282148 (♂) Calicoan I., Samar *barkeri*	254	191	54	—	58.6	25.3	—	7.9	10.8	10.6	11.0	9.2	9.4
No. 282145 (♀) Calicoan I., Samar *barkeri*	250	200	—	—	—	23.7	—	7.9	10.4	10.7	—	—	—
No. 282146 (♀) Calicoan I., Samar *barkeri*	269	175	50	—	—	—	—	—	—	—	—	—	—
No. 282147 (♀) Calicoan I., Samar *barkeri*	213	162	48	—	51.5	21.4	25.4	7.3	10.1	9.3	10.3	7.8	7.9
No. 125248 (♀) Mt. Apo, Mindanao *bagobus*, type	275[1]	128[2]	54	—	53.6	23.6	26.7	7.2	9.9	10.7	9.9	9.6	9.4

[1] External measurements from Mearns (1905, p. 451), made on dry study skin.

[2] Tail apparently incomplete.

larger molar teeth. There are no satisfactorily constant characters by which "*Bullimus*" can be retained.

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PHYSICS.—*Some experiments relating to the electrical conductivity of the lower atmosphere.*[1] G. R. WAIT, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

The factors that affect the electrical conductivity of the Earth's atmosphere vary considerably with altitude above the ground. In the present paper the discussions are intended to apply to those conditions that are encountered specifically in the Earth's lower atmosphere, that is, in the portion accessible to measuring instruments. There will be briefly described some of the more commonly employed methods of measuring the conductivity and a presentation made of a few results of measurements at some widely separated localities. Attention will also be called to some of the more important factors affecting this element, and finally some experiments will be described that have been carried out for the purpose of gaining a better understanding of the manner and the extent to which these factors operate in regulating and controlling the conductivity of the lower atmosphere.

It is well to bear in mind that, while considerable effort has been devoted to the isolation and the evaluation of various factors that affect the conductivity of the atmosphere at considerable altitudes, little attention has been given to such problems concerning the lower atmosphere. The greatest effort has been devoted to measurements of this conductivity, in order to secure a knowledge of its magnitude and character of variation with time and place under various conditions. Little effort has been given to learning why the conductivity varies in any particular manner. The desire to learn more concerning the underlying factors that contribute to the control of the conductivity of the lower atmosphere and how they operate has been a stimulus to the initiation of the experiments to be discussed.

The air about us is one of the best insulating substances known, comparing closely with amber, which is widely used and valued because of this peculiar property. Its conductivity is so small that it was long a question whether it existed at all. A conductor in air was found many years ago to lose its electric charge gradually. It was thought, however, that this might be due to the slow escape of charge over its supports. Coulomb, more than 160 years ago, first observed that the charge on a conductor inside a vessel disappeared at a rate proportional to the amount of charge on the body and that this rate appeared too great to be accounted for by the loss over the insulating supports. He believed that the air did actually conduct electricity and explained this on the basis of molecules of air coming into contact with the conductor, then being repelled with a resulting transfer of charge to the walls of the surrounding vessel. Later investigations, including those by Matteucci, Warburg, Boys, and Linss, furnished further evidence that the loss of charge by a conductor in air is not entirely due to its escape over the insulating supports. It was not, however, until the beginning of the present century that definite proof of this was obtained. H. Geitel and C. T. R. Wilson in the same year carried out experiments that took complete account of

[1] Address of the Retiring President of the Philosophical Society of Washington, delivered at the 1258th meeting of the Society on January 5, 1946. Received August 27, 1946.

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the loss of charge over the supporting insulators and found that the surrounding air did conduct electricity. In Geitel's experiments a correction was applied for the loss over the insulators. In Wilson's experiments the arrangement was such that a loss of charge over the insulating supports was prevented from occurring.

Experiments at the Cavendish Laboratory, at the beginning of the century under the direction of J. J. Thomson, threw considerable light upon the manner in which a gas conducts an electric current. The conductivity of a gas was observed to increase under the influence of X-rays and radioactive matter. When such influences were withdrawn, the conductivity of the gas gradually returned to normal. The conductivity was also found to diminish when the gas passed through glass wool and when it was slowly drawn between highly charged metal plates. To explain such electrical characteristics it appeared necessary to assume that the action of the X-rays and the radioactive matter was such as to produce electrically charged particles of both signs in the gas. The glass wool filtered the charged particles out of the gas while the action of the field between the charged plates removed the charged particles from the gas to the plates. The oppositely charged particles, after being produced, gradually recombined, thus accounting for the gradual reduction of the conductivity of the gas after the removal of the X-rays or radioactive matter. The charged particles in the gas were called "ions," as were also the charged particles in an electrolyte, which render the electrolyte electrically conducting. The ions in a gas similarly give the gas its conductivity, the positive and negative ions accounting for a positive and negative conductivity, respectively.

A number of different types of apparatus have been developed for the measurement of the conductivity of the air. One of the earliest was that devised by Elster and Geitel [see *1* of "References" at end of paper] in Germany during the early part of the present century. It consisted essentially of an electroscope to which was connected a small metal cylinder on which an electric charge could be placed. Over this cylinder another and larger earthed cylinder was fitted in order to protect it from the disturbing influences of the Earth's field. It was later shown that the measurements with this apparatus were somewhat open to question. It was used by E. Schweidler without the outer cylinder and in a location where it was not subjected to the Earth's electric field. In this way more accurate values of the conductivity were secured. Another and more precise method of measuring the conductivity of the air was developed by Schering (*2*), likewise in Germany. In the more improved form of the Schering apparatus a horizontally stretched wire, some 20 meters in length, is surrounded by an earthed open-mesh wire cylindrical screen at a distance of about 50 cm. The horizontal wire is connected electrically to an electrometer, which in some cases was adapted for automatic recording work. This type of apparatus has had considerable use at various stations in Europe in recording the conductivity of the air. Swann (*3*) showed that this type of apparatus, however, is subject to considerable error under conditions of little wind. He also pointed out the importance of installing the apparatus where it would not be influenced by the Earth's electric field.

The apparatus that is most commonly used today and that is free from the objections raised against most of those previously developed was designed by Gerdien (*4*) and described by him in 1905. It consists essentially of a cylindrical condenser, the inner member of which is connected electrically with an electrometer or electroscope. A fan draws a stream of air at a more or less constant rate through the outer cylinder. The inner cylinder, after being isolated from a battery, gradually loses its charge by catching oppositely charged ions which are drawn out of the passing stream of air. From the rate at which this electrode loses its charge, together with the constants of the apparatus, the conductivity of the air may be computed.

An improved form of Gerdien apparatus was designed by Swann (*5*) at the Department of Terrestrial Magnetism for automatically recording the conductivity of the air. The improvements included (1) the use

of a more sensitive electrometer, the steady deflections of which depend upon the value of the conductivity, and (2) means for the avoidance of an error which occurs in the earlier form of apparatus and which is due to the collection of radioactive matter on the cylindrical condenser.

Measurements of the conductivity were carried out over the ocean aboard the experimental vessel *Galilee* as early as 1907 by the Department of Terrestrial Magnetism. Later measurements were made over the ocean aboard the *Carnegie* on the six cruises from 1915 to 1921, and on the seventh cruise during 1928 and 1929. Continuous records of the conductivity have been obtained by the Department at several land stations since 1917, when the first recording apparatus was installed on top of the main laboratory building in the suburbs of Washington. At the present time continuous records of the conductivity are being obtained at three widely separated land stations, namely, the Watheroo Magnetic Observatory in Western Australia, the Huancayo Magnetic Observatory in Peru, at an altitude of 3,350 meters, and the Tucson Magnetic Observatory of the Coast and Geodetic Survey in Arizona.

The value of the conductivity of the lower atmosphere varies greatly from place to place over land and has both a diurnal and a seasonal variation. The causes for such variations will be discussed later. In Fig. 1 is shown the type of automatic daily record being obtained at the Department's observatories. In the reproduced records of positive and negative conductivity from Huancayo one sees that a zero point is obtained each hour. This zero is the result of the removal of all ions from the air-stream before it reaches the central cylinder. Between zeros the magnitude of deflection from the zero position affords a measure of the conductivity. The apparatus is a duplex system that records simultaneously the positive and negative conductivity. The bottom record is for the Earth's electric field (potential gradient) for the same day. This field results from an electric charge on the Earth's surface. The daily variation in potential gradient, as may be seen, is largely

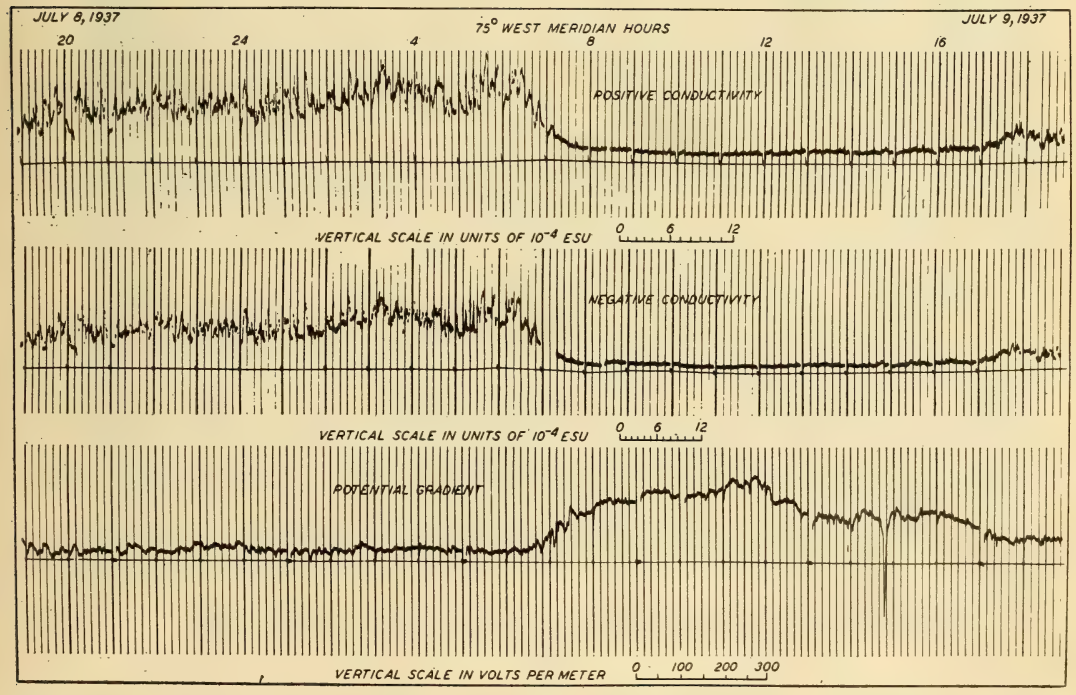


Fig. 1.—Electrograms, Huancayo Magnetic Observatory, "quiet" day during dry season.

opposite in character to that for the conductivity. This is due to changes in the conductivity of the atmosphere. Whether or not a decrease in conductivity is accompanied by an increase in potential gradient depends on whether this decrease is confined to a relatively thin layer of the atmosphere or whether it extends throughout the entire vertical column of the atmosphere. It might be explained that as a consequence of the Earth's charge an electric current passes to the Earth through the atmosphere and is known as the "air-earth current." From Ohm's law one can write $G=i/\lambda$, where G is the value of the potential gradient, i is the value of the air-earth current density, and λ is the total conductivity of the air. If the value of λ varies only in a thin layer of the atmosphere, the value of i is not appreciably affected; consequently

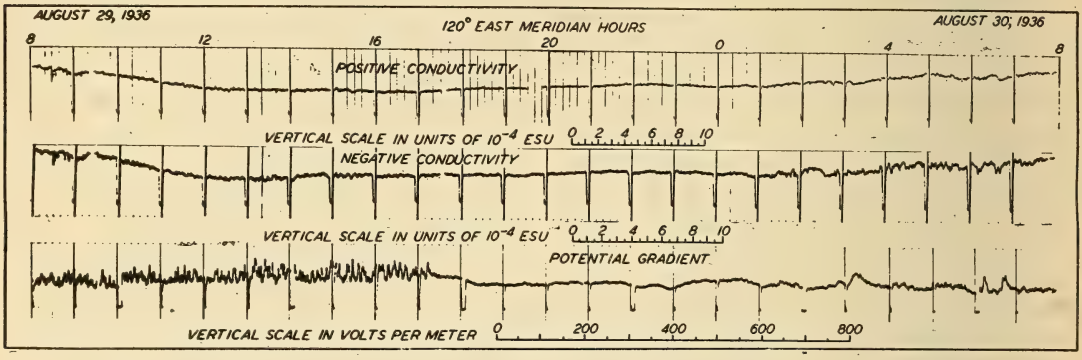


FIG. 2.—Electrograms, Watheroo Magnetic Observatory, "quiet" day.

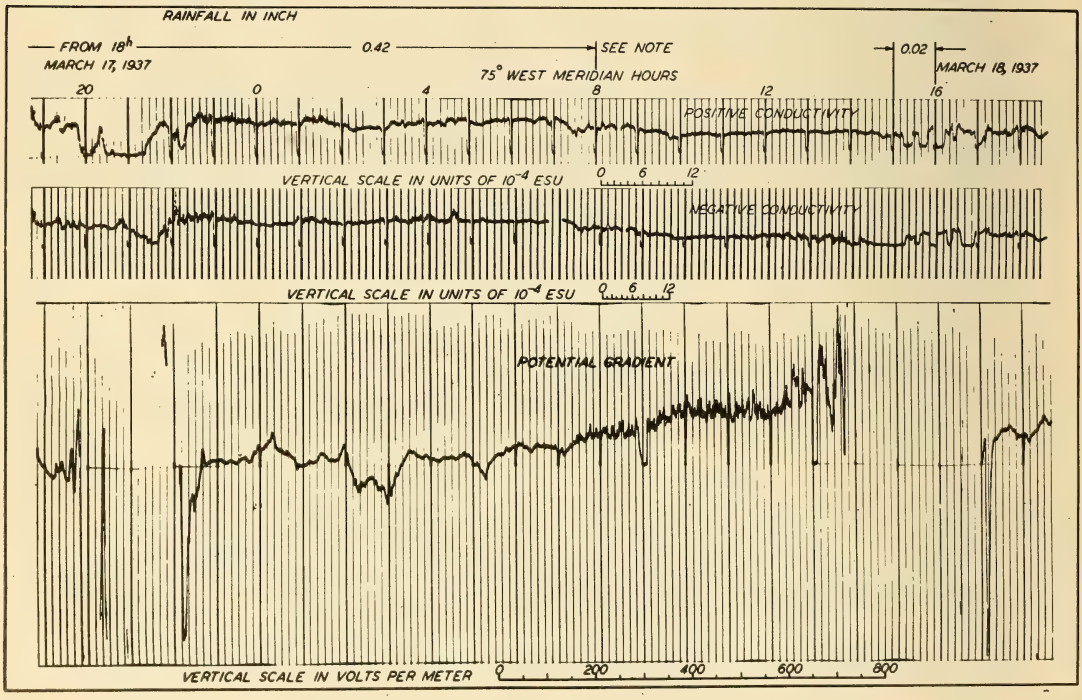


FIG. 3.—Electrograms, Huancayo Magnetic Observatory, rainy day. (Note: Clearing in morning after $10^h.5$, early afternoon March 18, increasing cloudiness, distant rain, and thunder to southwest at 14^h).



G. R. Wait
President, Philosophical Society of Washington
1945

the gradient in this layer will vary as the value of $1/\lambda$. Since this is the type of daily variation found at Huancayo, it is concluded that such changes in conductivity are confined to a relatively thin layer of the lower atmosphere. On the other hand, if the decrease in conductivity occurs uniformly throughout the entire vertical column of the atmosphere, the value of both i and λ will be diminished in the same proportion. The value of the ratio i/λ, and consequently that of G, will then remain unaltered. This is largely the condition prevailing at Watheroo, as may be seen from Fig. 2, which shows a typical fair-weather diurnal-variation curve for the conductivity of each sign and for the potential gradient. During a thunderstorm not only is the potential gradient often disturbed but the conductivities may also be affected when these disturbances are great. In Fig. 3 is shown the type of record frequently obtained during a thunderstorm. The bottom curve represents the atmospheric potential gradient at Huancayo, which was recorded simultaneously with the conductivities of both signs. It is apparent that, at times of very intense electric fields, the conductivity of the air was likewise disturbed. The effect, in general, is such as to cause a diminution in the value of the conductivity of only one sign. The conductivity of the opposite sign at that particular time appears more or less undisturbed. The sign affected depends upon whether the potential-gradient curve is above or below the base line. When above the base line, the potential gradient is positive (negative charge on the ground) and the negative conductivity is affected. When below, the opposite takes place. That is, the sign of conductivity affected is always the same as that of the charge on the ground below the point of observation. The reduced conductivity, which is due to reduced number of ions per unit volume in the atmosphere, is attributed to the fact that the intense field removes the ions almost as fast as they are produced.

The conductivity of the air over the open ocean proceeds generally uniformly with time. The influences of land areas may often be observed many miles out to sea. This may be illustrated by the record of conductivity of the air over the ocean as obtained aboard the *Carngeie* during her last cruise, and shown in Fig. 4. It is apparent that the conductivity was steady relatively far from land, but less steady near land. Incidentally, the conditions determining the ionic equilibrium over the ocean, and hence the average value of the conductivity of the air over this region, appear to undergo a gradual change through the years. The change is of such a nature as to cause a gradual decline in the conductivity. To illustrate the character and magnitude of such changes, a plot of the mean conductivity over various areas of the oceans is shown in Fig. 5, the data of which were obtained aboard the *Carnegie*. Each point on this plot represents the mean conductivity for a particular leg of a cruise. Each mean is composed of a number of observations since in general one set was taken each day. For example, in the case of the leg labeled Europe-America, there were 13 observations for the 1913 point and 20 observations for that of 1928. A possible cause for the decline in conductivity will be discussed later.

The presence of appreciable quantities of smoke has a marked effect upon the conductivity of the air. This is illustrated by the diurnal-variation curves of the conductivity at Watheroo, together with curves for certain other atmospheric-electric elements which are shown in Fig. 6. Two sets of curves for the conductivity are given, one for the case when there was considerable smoke in the air, the other with little smoke. It is apparent that the presence of smoke reduces the conductivity. The manner in which this is accomplished will be taken up later in this article. It might be noted, however, that the value of the air-earth current density is also reduced when smoke is present. Since the dimunition of the current is relatively less than that of the conductivity, the decrease in the latter does not extend throughout the entire vertical column. That is, the smoke does not extend all the way up to the upper conducting layer.

The average value of the conductivity of the air varies considerably from place to

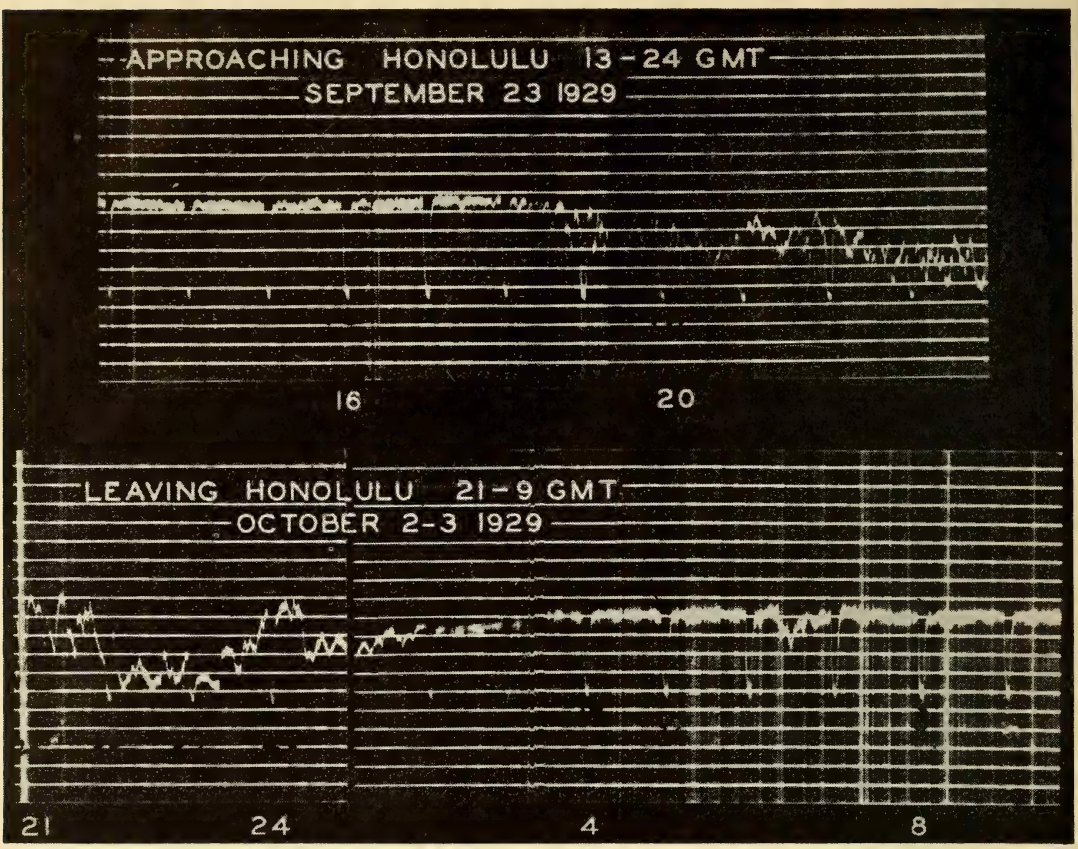


FIG. 4.—Air conductivity over the ocean recorded on the *Carnegie*.

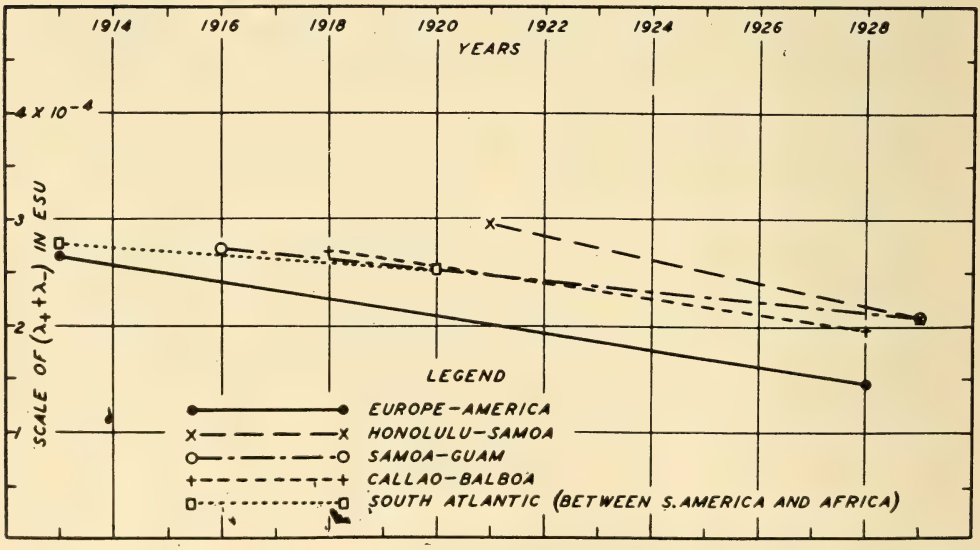


FIG. 5.—Decline through the years in conductivity of air over the ocean.

place over land as illustrated by diurnal variation curves for the total conductivity (positive plus negative) for two seasons of the year for the three land stations as shown in Fig. 7. The mean conductivity at Huancayo is somewhat greater than that usually encountered over land and that at Washington is somewhat less. The lower air pressure at a high altitude station such as Huancayo will result in an increased conductivity due to an increase in velocity of the ions. Neither the high values observed at this station, as compared with those observed at Washington, nor the large

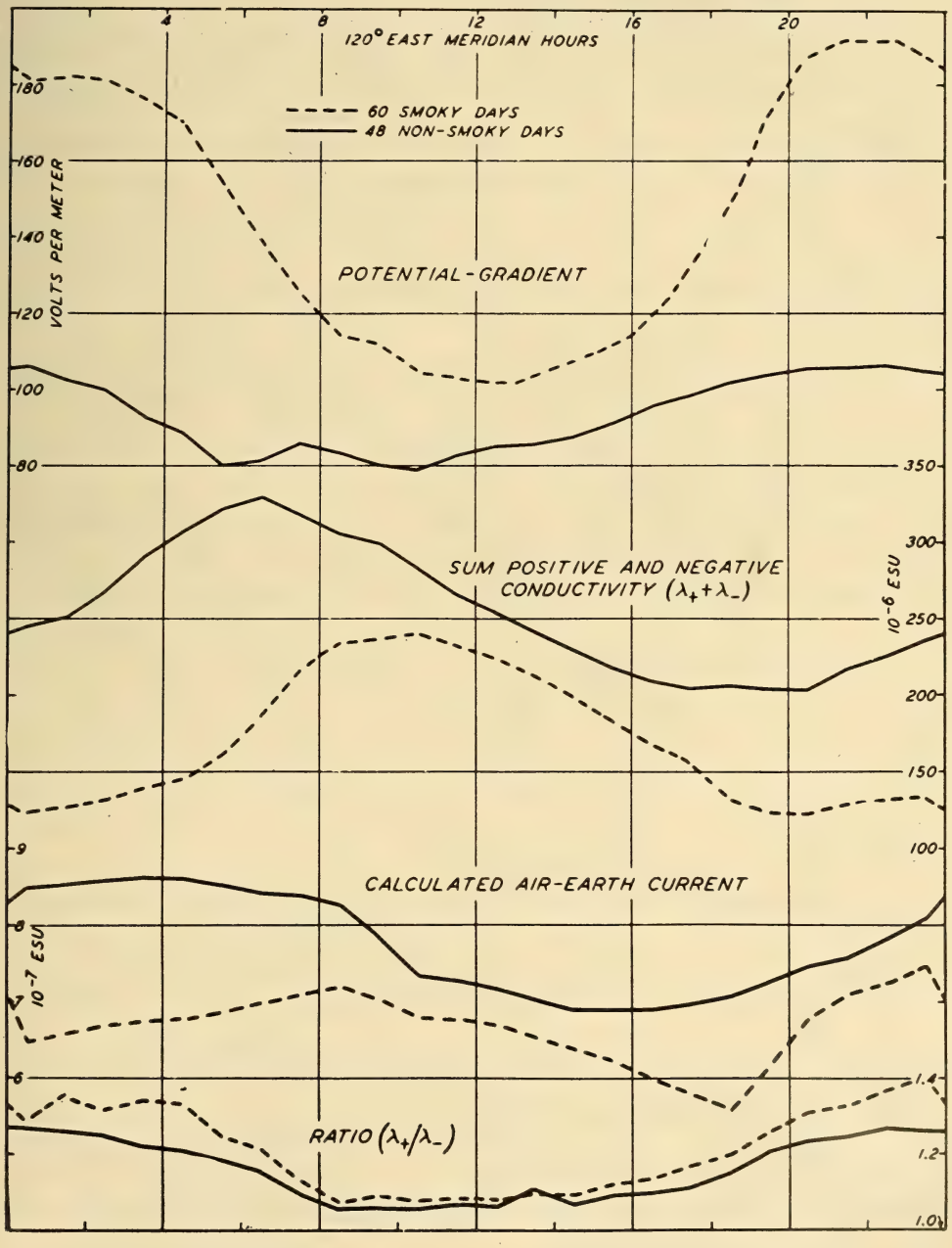


Fig. 6.—Diurnal variation of atmospheric-electric elements at Watheroo for smoky and non-smoky days during February, 1925–1934.

amplitude can be entirely explained in this way. The conductivity of the air at Washington, on the other hand, is very low, attributable in part to the influence of the city. To secure information concerning the influences of a city on various atmospheric electric elements, a survey was carried out several years ago in and about the city of Washington by the Department of Terrestrial Magnetism (*6*) that included, among other elements, the total conductivity ($\lambda_+ + \lambda_-$) of the atmosphere. The values of the total conductivity during this survey are given on the map shown in Fig. 8. Within the city limits, as may be seen, the values are much smaller than those in the nearby rural areas, the smaller values being confined to a rather restricted region within the city. As a further check on these results, a more recent but briefer survey was carried out by means of a quick-acting portable conductivity apparatus mounted on a station wagon. The apparatus responded to the conductivity of the air as the wagon was

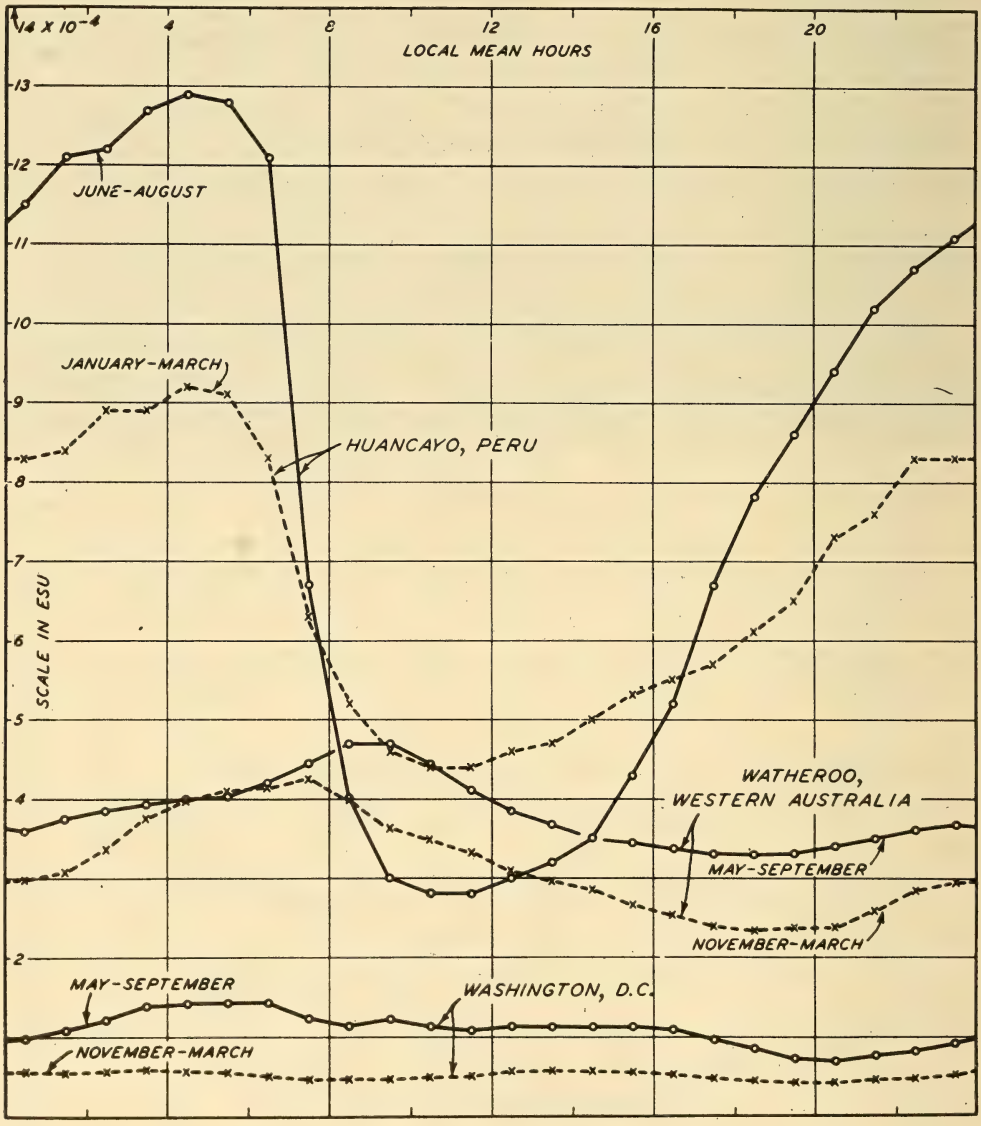


FIG. 7.—Total conductivity of atmosphere for 1930, at Watheroo, Huancayo, and Washington.

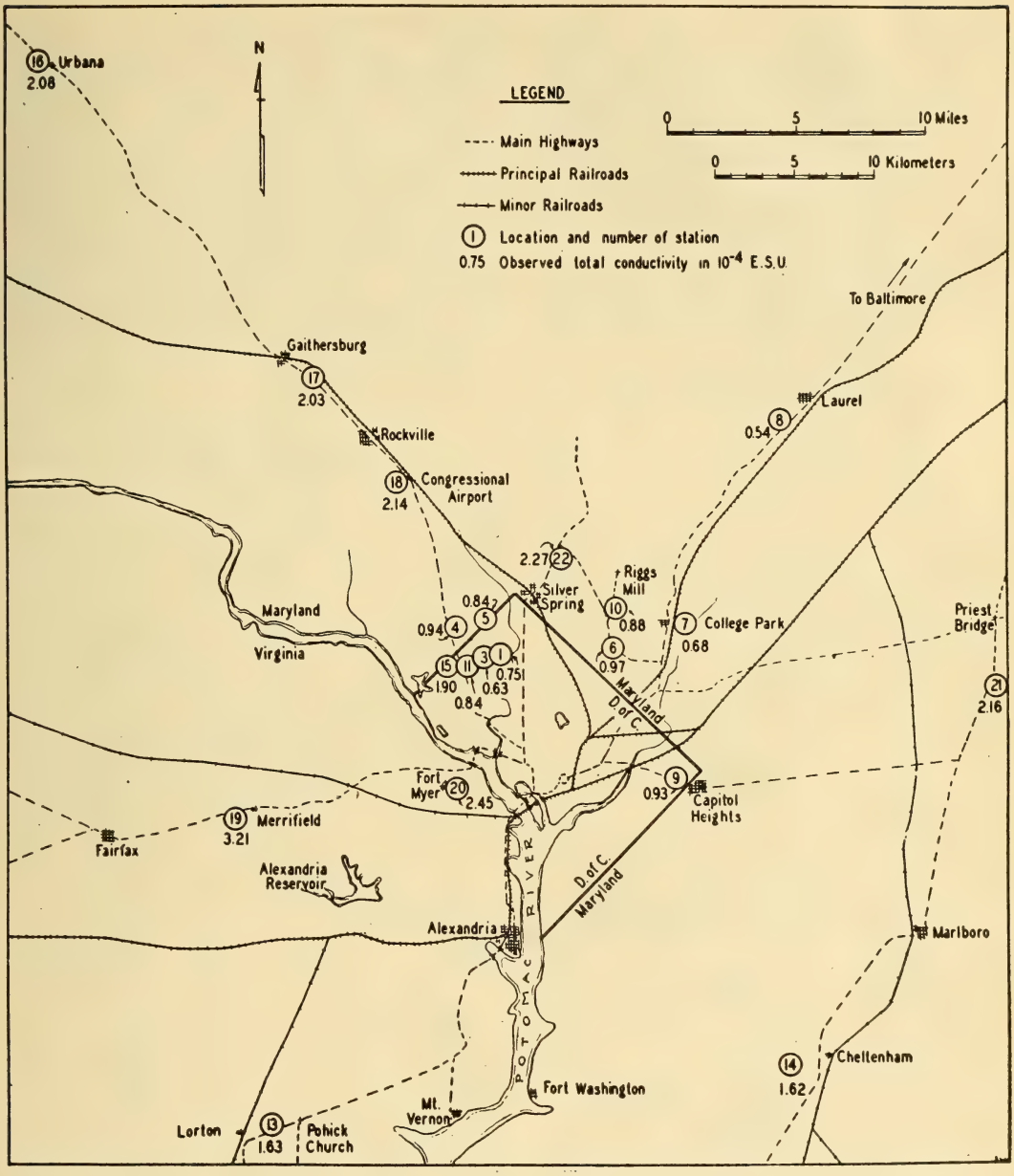


Fig. 8.—Conductivity of air in Washington area observed during October, 1930.

driven along the road at about 20 miles per hour, so that all the results were taken within a few hours of one another. On the previous survey the observations extended over several weeks. The results of the later survey are given on the map of Washington and vicinity and shown in Fig. 9. The agreement in the results of the two surveys is extremely good, both showing very low values within the city and a gradual increase to higher values, amounting to some three or four fold, as one approaches the open country. What are the conditions within a city which produce a less conducting atmosphere? Such conditions, one might point out, are not confined to the surface

layer of air but extend above the city to considerable heights. One might well ask why the conductivity of the lower air varies as much, let us say, as one order of magnitude from place to place and yet does not amount to so much as two orders of magnitude. To answer these and other questions it is necessary to inquire into the causes of the conductivity of the atmosphere and to examine the factors that control or regulate its value. Recalling that the conductivity, λ, is given by the equation $\lambda = nek$, where n is the number of small ions per cc, e is the value of the unit electrostatic charge, and k is the mobility of the ion, it is apparent that to affect the value of λ one of the three factors indicated above must be altered. The value of e has been accurately determined, and various investigations have shown that only one charge is normally found on the ion to which the conductivity of the air is principally due. The value of k for this ion has also been measured and found to vary within rather narrow limits

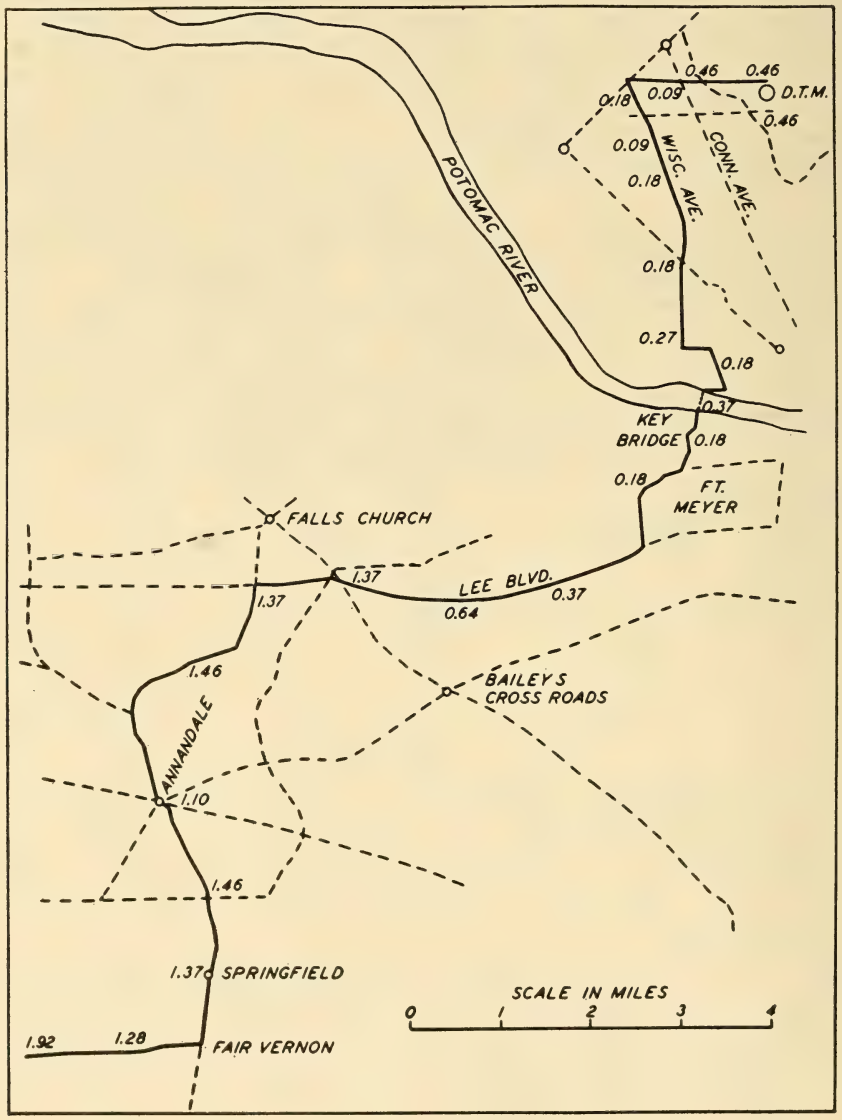


FIG. 9.—Electrical conductivity of the atmosphere (in 10^{-4}esu), Washington, D. C., and vicinity, March 21, 1945.

for conditions encountered in the lower atmosphere. The remaining factor, the number of ions per unit volume, must be the principal variable and the controlling factor.

Only one type of ion has been referred to thus far in discussing the conductivity of the atmosphere because the conductivity may be attributed almost exclusively to it. All the types of ions present in the atmosphere however, contribute to the conductivity; to obtain the total conductivity, one must sum up the individual contributions. In Washington, for example, there are three discernible ion types, the so-called small ion of molecular dimensions, the large or Langevin ion, which has a diameter about two orders of magnitude greater than that of the small ion, and the intermediate ion (7) with a diameter intermediate between the other two types. The conductivity due to the three types of ions thus becomes $\lambda = e(nk + n_i k_i + NK)$ in which e represents the electronic charge and n, n_i, and N represent the number per cc of the small, intermediate, and large ions respectively; k, k_i, and K represent the corresponding mobilities. Typical values observed around Washington are given in Table 1:

TABLE 1

	Small ions	Intermediate ions	Large ions
Number per cc...	200	150	5000
Mobility[1].....	1.5	0.7	5×10^{-4}

[1] Values are in cm/sec/volt/cm.

Calculating the conductivity by substitution of the above values one obtains: $\lambda = 4.3\times10^{-7}[100+3.5+0.8] = 0.45\times10^{-4}$ ESU. From this it may be seen that the intermediate ion contributes only 3.5 percent, while the large ion contributes only 0.8 percent of that contributed by the small ion.

The large ions do not generally contribute in great measure to the conductivity of the lower atmosphere; their importance is due to the influence they exert upon the number of small ions present. Hence, the large ions set a limit to the value of the conductivity and, if numerous, regulate the value of the conductivity of the atmosphere. Thus, we have an explanation of the very low value of conductivity for the smoky days at Watheroo and also that obtains within the city, and the relatively higher value in the open country districts. Within the city, for example, the large ions are relatively more abundant than in the rural areas. The reason for this is that they are produced abundantly in the exhaust gases of automobiles and by practically all other forms of combustion. The particle that is liberated in such a process acts as a center or nucleus around which moisture condenses from the atmosphere to form fog, mist, or cloud and is known as a condensation nucleus. All condensation nuclei found in the lower atmosphere do not necessarily originate from combustion, but this plays a most important part. Not all the condensation nuclei in the atmosphere are electrically charged. In Washington about a fourth are electrically charged and hence are large ions. The number of positive and negative large ions are approximately equal except under special circumstances. Just why the number of small ions in the air is reduced when condensation nuclei are present, deserves consideration.

The number of small ions in a given volume of air, if we assume that none is mechanically brought into the volume or removed, depends upon how fast they are produced and how fast they recombine and combine with the charged and uncharged condensation nuclei. In a closed vessel freed from condensation nuclei the equation leading to ionic equilibrium, if the number of positive and negative ions is equal, is $dn/dt = q - \alpha n^2$, where α is the coefficient of recombination of the small ions. In a volume containing charged N and uncharged N_0, condensation nuclei, this equation must be modified in view of the combinations between the nuclei and the small ions. If the positive and negative large ions are equally numerous the corresponding equation becomes $dn/dt = q - \alpha n^2 - \eta N n - \eta_0 N_0 n$, where N and N_0 are the number per cc of charged nuclei of one sign and uncharged nuclei respectively while η and η_0 are the coefficients of combination between the small ions and the respective nuclei. Under equilibrium conditions for large ions and condensation

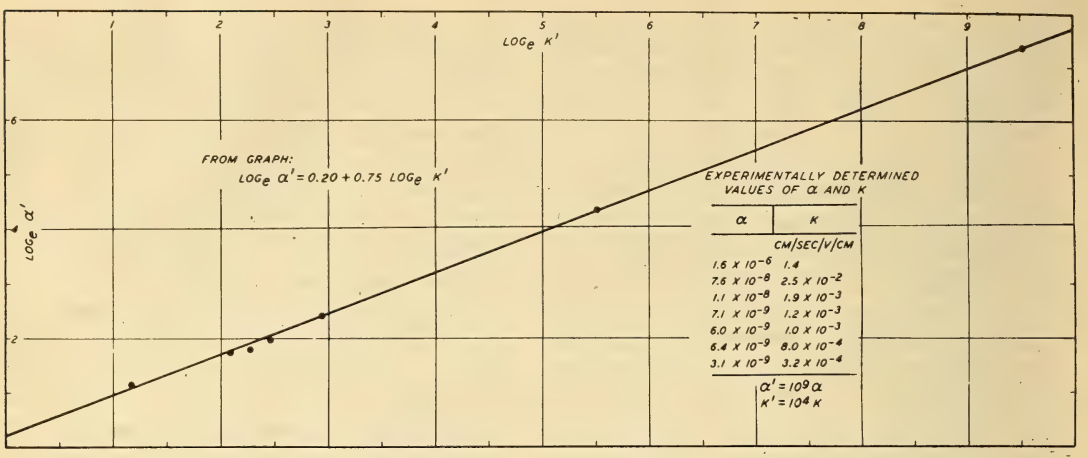


FIG. 10.—Empirical relationship between mobility (K) and recombination coefficient (α) of gaseous ions.

nuclei, the relation may be written approximately $\eta Nn = \eta_0 N_0 n$, hence, when $dn/dt = 0$, $q = \alpha n^2 + 2\eta Nn$. For average conditions in Washington the value of the term αn^2 is only a few percent of the quantity $2\eta Nn$ and may be neglected in nearly all cases, whence, the above equation becomes $q = 2\eta Nn$. For a constant value of q, the number of small ions per cc is consequently inversely proportional to the number of large ions.

A similar equation involving the number of condensation nuclei, N_A, per cc in the place of the number of large ions may be written in view of the known relationship between the number of charged and uncharged condensation nuclei. The number of condensation nuclei is equal to the sum of charged and uncharged nuclei, that is, $N_A = N_1 + N_2 + N_0$. If every charged nucleus has a single charge then N_1 and N_2 refer to both the number of unit charges and to the number of charged condensation nuclei, positive and negative, respectively. If we assume on the basis of the above equation that $\eta Nn = \eta_0 N_0 n$ and $q = 2\eta Nn$, it follows that $q = 2\eta/[(\eta/\eta_0) + 2]N_A n$, which may be rewritten $q = 2\omega N_A n$ where ω acts as the combination coefficient between small ions and condensation nuclei. To test the validity of the above equation it is necessary to secure not only measurements on the number of small ions per cc but also on the number of condensation nuclei.

An apparatus was developed more than 50 years ago by John Aitken (*8*), a Scotch engineer, for counting condensation nuclei in the atmosphere. A small model of a larger laboratory apparatus, which he carried in his coat pocket, was used by Aitken and is the type of instrument most commonly used today. The apparatus operates on a principle similar to that of the Wilson cloud chamber. It employs an air pump by which the air pressure in a small chamber is suddenly reduced. The resulting expansion of air is not sufficient to permit the condensation of moisture (water being present in a saturated blotter) around small ions, as in the case of the Wilson cloud chamber, but it does permit the condensation around the nuclei because this takes place at a lower supersaturation. Visible droplets of water thus formed fall under the force of gravity, and the number of nuclei per cc in the outside atmosphere is determined from the number of droplets falling, if the volume of air used as a sample and the constants of the instrument are known.

Two separate instruments are used for counting the ions of the atmosphere, since a single instrument can not be suitably designed for counting both the large and the small ions. The small-ion counter as used at the Department is so placed that the airstream enters this instrument before it enters the large-ion counter. The small and large ions are, therefore, taken from the same sample of air. Each ion-counter is provided with its own electrometer, the deflections of which provide a measure of the

number of ions collected. These apparatus have been used extensively to record ion-content of the open air and in closed rooms.

In the development of the equation $q=2\eta Nn$ we considered as negligible the recombination between large ions. Though it is quite certain that the recombination coefficient α for this ion is small, there is some doubt as to the value for the large ion found in the air. Kennedy made the first determination of the value of α and obtained 6.3×10^{-10}. Later Hogg obtained a value of 1.7×10^{-8}. The value of α varies with the size of the ion, and it seems probable, therefore, that Hogg's measurements applied to a smaller ion. Although size of the ion can not be directly determined, it may be inferred from the value of the mobility K, which can be measured. Under the circumstances it was considered important that determinations be undertaken of both α and K for the same ion. The writer has accordingly made measurements over a wide range of mobilities. The lowest mobility is applicable to the large ion of the atmosphere (10^{-4} cm/sec/v/cm), while the highest is about two orders of magnitude greater. Only a summary of the results will be presented without describing the methods employed in the determinations. The values of α and K are found to fit an empirical equation of a simple form. The plot of $\log_e \alpha'$ against $\log_e K'$ results in a straight line that includes the values by others for the small ion shown in Fig. 10, from which it is seen that $\log_e \alpha' = D + S \log_e K'$, where $\alpha' = 10^9\alpha$, $K' = 10^4 K$, and where S and D are constants having the values 0.75 and 0.20, respectively. Unfortunately, no adequate theoretical consideration has been given to any possible relationship between α and K. A recent consideration by W. E. Harper applies only to pressures of about 10 atmospheres and consequently fails to meet the need in the present instance.

In correlating the total nuclei and the large ions it is important to know whether each large ion carries more than one charge. Determinations of the number of unit charges per large ion have been made at the University College, Dublin, in ordinary room air. Mr. Torreson and the writer (*9*) made similar determinations in the laboratory in Washington for ions in outdoor air as well as for ions artificially produced from burning gas. To determine the charge per ion the following procedure was followed: the nuclei-content, N_A, of the air is taken before it enters the ion counter and again after it has passed through the counter, the latter count giving the number (N_0) of uncharged nuclei. The difference between the total number of nuclei and the number of uncharged nuclei ($N_A - N_0$) represents the number of charged particles. The total number of charged particles is then compared with the total number of unit charges measured with the large ion counter to obtain the charge per ion. The results by Nolan, Boyland, and deSachy, at Dublin, for room air show that the charge per ion is unity. From the results by Torreson and the writer similar results were found for the outside air in Washington and for ions artificially produced from burning gas. Table 2 illustrates the results obtained in the latter case. From all these results it seems justifiable to assume that in general the charge per large ion is unity as has previously been found for the small ion.

TABLE 2.—NUMBER OF PARTICLES IN CHAMBER (180 CUBIC METERS) AFTER EXTINGUISHING FLAME, CORRESPONDING NUMBER OF UNIT-CHARGES PER ION, AND PROPORTION OF PARTICLES UNCHARGED.

Time minutes	Particles per liter			$\frac{N_A - N_O}{2.15}$	Number of unit-charges per particle	Percent of particles uncharged
	Total (N_A)	Uncharged (N_O)	Positively charged (N_+)			
5	175.6	141.5	15.85	15.90×10^3	1.00	81
6	128.0	95.0	15.32	15.35×10^3	1.00	74
7	97.5	67.5	14.50	13.95×10^3	1.04	69
8	89.0	60.0	13.76	13.49×10^3	1.02	67
9	88.0	60.0	13.42	13.02×10^3	1.03	68
10	87.5	60.0	12.85	12.80×10^3	1.00	69
11	87.0	60.0	12.39	12.56×10^3	0.99	69
12	86.5	60.0	11.95	12.33×10^3	0.97	69
Means					1.01	71

Simultaneous records of the small and the large-ion content of the outdoor air in Washington, D. C., were obtained by Mr. Torreson and the writer (*9*) over the period of a year beginning in October 1932. The resulting data have been separated according to seasons and are shown in the form of

diurnal variation curves in Fig. 11. The large-ion content of the air during the cold season is considerably greater than during the warm season. This is in large part due probably to the increase in smoke and gases given off by domestic fires. The diur-

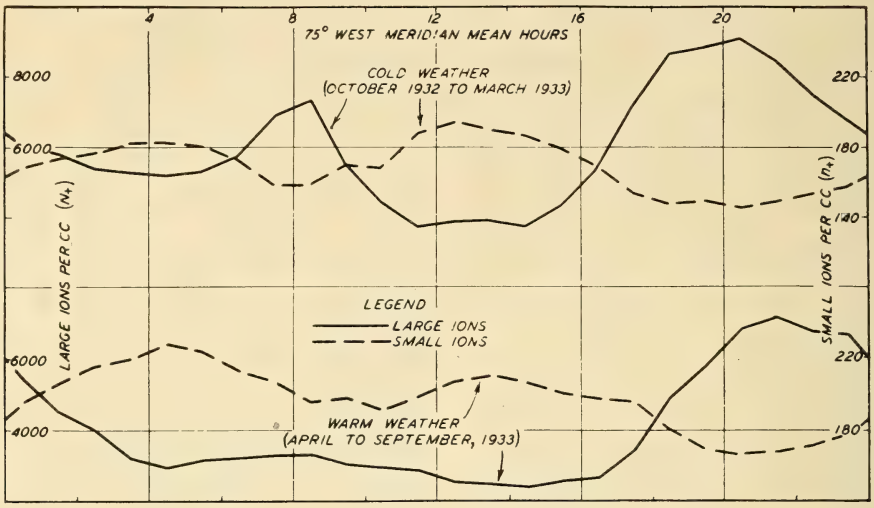


FIG. 11.—Seasonal diurnal—course in positive large ions and positive small ions—cold weather (October 1932 to March 1933) and warm weather (April to September 1933), Washington, D. C.

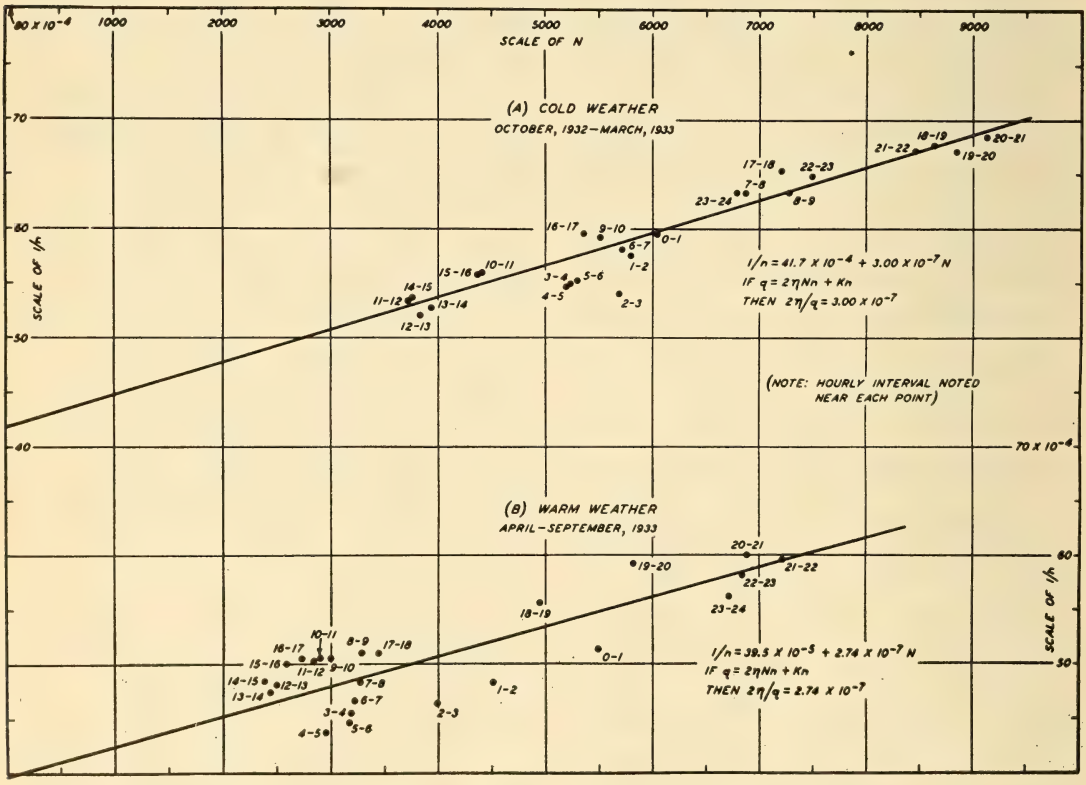


FIG. 12.—Relation between large and small ions at Washington, D. C.

nal variation in large ions is to be explained probably in a similar manner. The small-ion content varies more or less in a manner inverse to that of the large-ion content for both seasons as is to be expected on the basis of the equation $q=2\eta Nn$. For a better quantitative comparison of the inverse relationship between the two types of ions in the air, the reciprocal $1/n$ of the small-ion content is plotted against each corresponding value of the large-ion content for the two seasons, and the resulting curves are shown in Fig. 12. From the relationship indicated by the two curves it is seen that the value of $1/n$ varies directly as the value of N, but it is not zero when the value of N is zero. The general relationship between the two elements is expressed in the equation $1/n=AN+K'$. The value of q is usually regarded as approximately constant, and the equation may be rewritten as: $q=2\eta Nn+Kn$. It indicates that the small ion is removed from the atmosphere not only through combination with charged and uncharged nuclei but also by some other process since the ordinate at the intercept is too great to be accounted for by recombination of the small ions. One possible explanation of such removal is by attachment to gross particles which are too large to be counted either by the large-ion counter or the nuclei counter. Recently J. J. Nolan (*10*), of University College, Dublin, found a similar relationship between the small-ion content and the condensation-nuclei content of the air, employing data from four land stations. These results taken with those obtained in Washington give further indication of a need for a revision of the equation as given above.

We have shown that variations in the numbers of condensation nuclei alter the number of small ions, but since the number of small ions is also affected by q, the rate at which they are produced, special consideration must be given to the variation of q with time and the factors that govern its variation. The ionization, or production of small ions in the atmosphere, is chiefly attributable to the cosmic rays and radiations from radioactive matter in the soil and atmosphere, as indicated in Table 3. Radioactive matter, such as radium, thorium, and actinium, is found distributed throughout the Earth's crust. As these elements decay, there are formed radon, thoron, and actinon, which behave chemically like the group of inert gases, argon, neon, etc. These gases tend to escape from the soil into the air. There occur, therefore, in the atmosphere not only radioactive gases but also each successive radioactive product such as radium *A*, radium *B*, etc. All the radioactive gases as they decay give off alpha rays only. Some of the decomposition products give off alpha rays only, others beta and gamma rays, and still others all three. A precise determination of q can be secured by measuring the effects not only of the beta and gamma rays but also of the alpha particles, which are so easily stopped that they can penetrate only a few centimeters of air.

TABLE 3.—IONIZATION[1] OF THE AIR BY COSMIC RAYS AND BY RADIOACTIVE MATERIALS IN THE SOIL AND AIR.

Radioactive material	Source of ionization (In percent of total)				Total
	α	β	γ	Cosmic rays	
Radium in air	30	1	1	—	32 } 51
Thorium in air	18	1	—	—	19 }
Radium in soil	—	1	32	—	33
Thorium in soil				16	16
Total.....	48	3	33	16	100

[1] As estimated by Hess.

In view of the difficulties, previous attempts were confined to rough estimates of q, obtained at a particular time, never continuously, or throughout a whole day. But even such attempts to estimate the character of the diurnal variation were regarded as of considerable importance.

In our investigations use was made of an ionization chamber and electrometer, arranged to give an automatic record of the ionization inside the chamber. The walls of the chamber were constructed of sufficiently thin material to permit the penetration of alpha particles from the radioactive matter outside producing ions within. Thin cellophane (the alpha-ray stopping power of

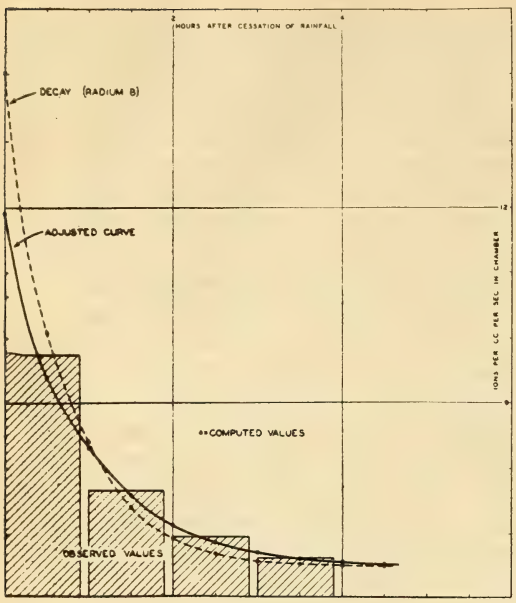


FIG. 13.—Ionization-decay following thundershower (mean 8 showers, Washington, D. C., summer 1933).

which corresponded to about one and one-half centimeter of air) stretched over an open mesh brass cylindrical screen, was used to form the outer wall.

The complete ionization of the outside atmosphere can not be measured by such an apparatus because a portion of the alpha particles are absorbed while passing through the wall and because the radioactive matter enclosed within the chamber gradually decays. The apparatus is, however, capable of furnishing interesting and valuable information concerning the variations in q of the outside atmosphere.

During the first summer of operation it was frequently found that during an intense thunderstorm the ionization of the air increased by as much as 100 or 200 percent. McNish and the writer have investigated this matter (*11*) and have found that the most rapid increase in ionization generally occurs with the beginning of the heaviest rainfall. After the passing of the storm the rate of ionization slowly returns to normal. The rate of return closely coincides with the rate of decay of radium B, as may be seen

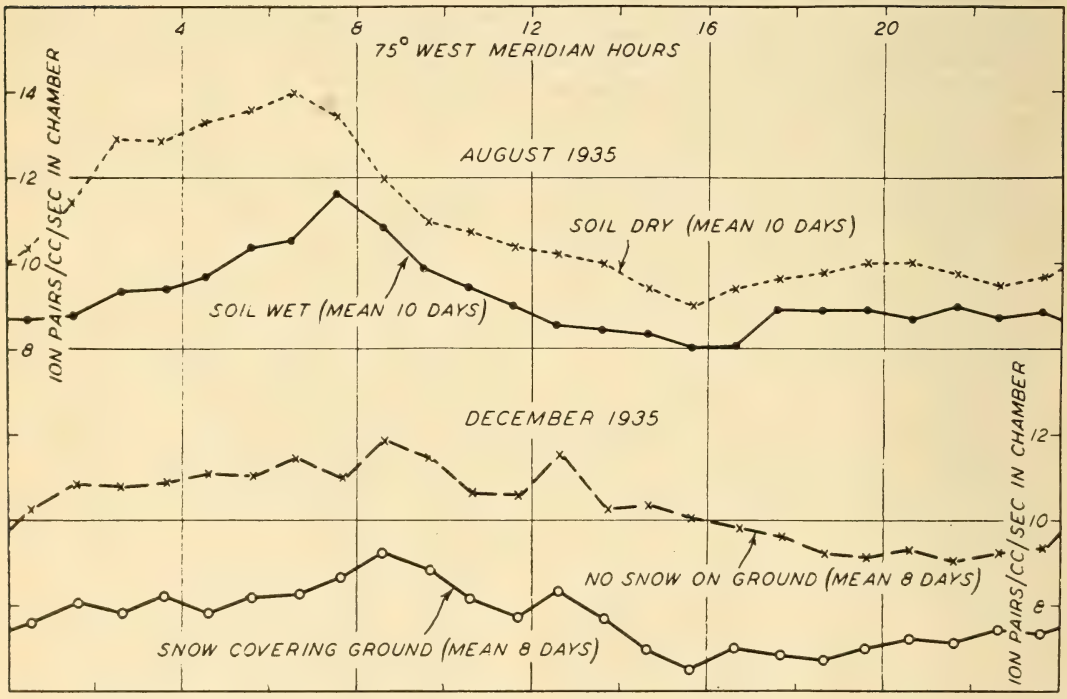


FIG. 14.—Measured rate ion-production inside thin-walled chamber, Washington, D. C.

from the curves of Fig. 13. These results are interpreted to mean that, at the time of the formation of the thunderstorm, convective action carries radioactive matter from the vicinity of the ground into the clouds, where it is dissolved in the moisture of the cloud. As the clouds pass the station the radioactive matter is brought down with the rain, thus increasing the amount already present. A thundercloud, in accordance with this theory, contains radioactive matter in a greater or lesser amount. This radioactive matter will result in an increase in the electrical conductivity of the air in the vicinity of the cloud.

The rate of ionization of the air near the ground was found to vary considerably with the condition of the soil. A reduction in value occurs when the soil is covered with snow and when it is wet. These results are illustrated by Fig. 14, which permits a comparison of diurnal variation curves of the rate of ionization when the soil is dry with that when it is wet and also when the ground is covered with snow with that when it is not. It is apparent that the wet soil and also the covering of snow have appreciably reduced the rate of ionization of the air. The reduction in the case of the wet soil was greatest during the early-morning hours, thus altering somewhat the character of the diurnal variation curve. In attempting an explanation of the reduced ionization in the two cases cited, it should be recalled that much of the ionization of the air is due to the presence of radioactive matter and that this matter originates from radioactive gases that came from the soil. A blanket of snow and the moisture in the small capillaries in the soil inhibit the escape of the radioactive gases and consequently reduce the amount of radioactive matter in the atmosphere resulting in a reduction in rate of ionization.

From the curves just shown it is apparent that an important diurnal variation occurs in the rate of production of small ions in the lower atmosphere with somewhat different characteristics in summer and winter. The rate of production for both seasons passes through a maximum during the early-morning hours and a minimum during the evening. The diurnal variation is more pronounced in summer than in winter. It is probably due to the fact that during the night hours radioactive matter accumulates in the lower atmosphere and is dispersed vertically as the wind increases in morning hours. It is probable that the more pronounced convective air currents are responsible for the greater diurnal variation in summer. This diurnal variation, together with that of large ions, accounts in large part for the diurnal variation in conductivity of the air.

It seems reasonable to suppose that a fall in barometric pressure has a tendency to drive radioactive gases from the soil. An increase in temperature of the soil would have a similar effect. As a consequence, the amount of radioactive matter in the air would show an increase under such circumstances. Some observers seem to have found an increase in the radium *A* content of the air with a falling barometer and also with an increase in temperature while others have found no such effects. McNish and the writer have secured continuous records of the ionization of the atmosphere for both decreasing barometric pressure and increasing temperature here in Washington; the results are shown in Fig. 15. Inspection of the curves fails to disclose any important changes in the ionization with changes in barometric pressure or temperature, thus indicating that any effect is not pronounced. Any possible relationship can, therefore, be disclosed only by statistical treatment employing a considerable number of data.

For some of the tests the apparatus for counting the small and large ions was set up in the main building where, it was hoped, conditions would be more uniform and to some extent subject to control. It was believed that the various elements to be measured, in contrast to results obtained outside, would probably not vary greatly through the day. The measurements soon proved this belief to be fallacious. On Sundays no diurnal variation was observed. On other days it was found to be large. Furthermore, the variations suggested dependence on the occupancy of the building by people. When they came to work in the morning the number of large ions in the room began to increase and the

number of small ions, as a result, to decrease. When the building was vacated at night the reverse changes occurred. Throughout the week there appeared to be superimposed on the systematic diurnal variation a gradual accumulation of large ions in the room and the number of small ions accordingly showed a gradual decrease in number. At 1 o'clock on Saturday, when occupancy of the building terminated for the weekend, the number of large ions began gradually to decrease. This decrease prevailed until Monday morning when the building was again occupied. The number of small ions always showed the opposite changes in rather faithful detail. These results are summarized by the curves shown in Fig. 16. Not all the reasons for these changes have as yet been ascertained; two of the more important, however, are as follows: (1) Tobacco smoke from other parts of the building entered the room in spite of attempts to seal the room from other parts of the building, and no smoking occurred in the room itself; (2) particles, considerably larger than those constituting tobacco smoke, are given off in the human breath and accumulate in the air of the room. Many of the particles in the tobacco smoke and in the breath are electrically charged and are consequently large ions. Other tests have shown conclusively that every exhaled breath contains several hundred million particles, the great major-

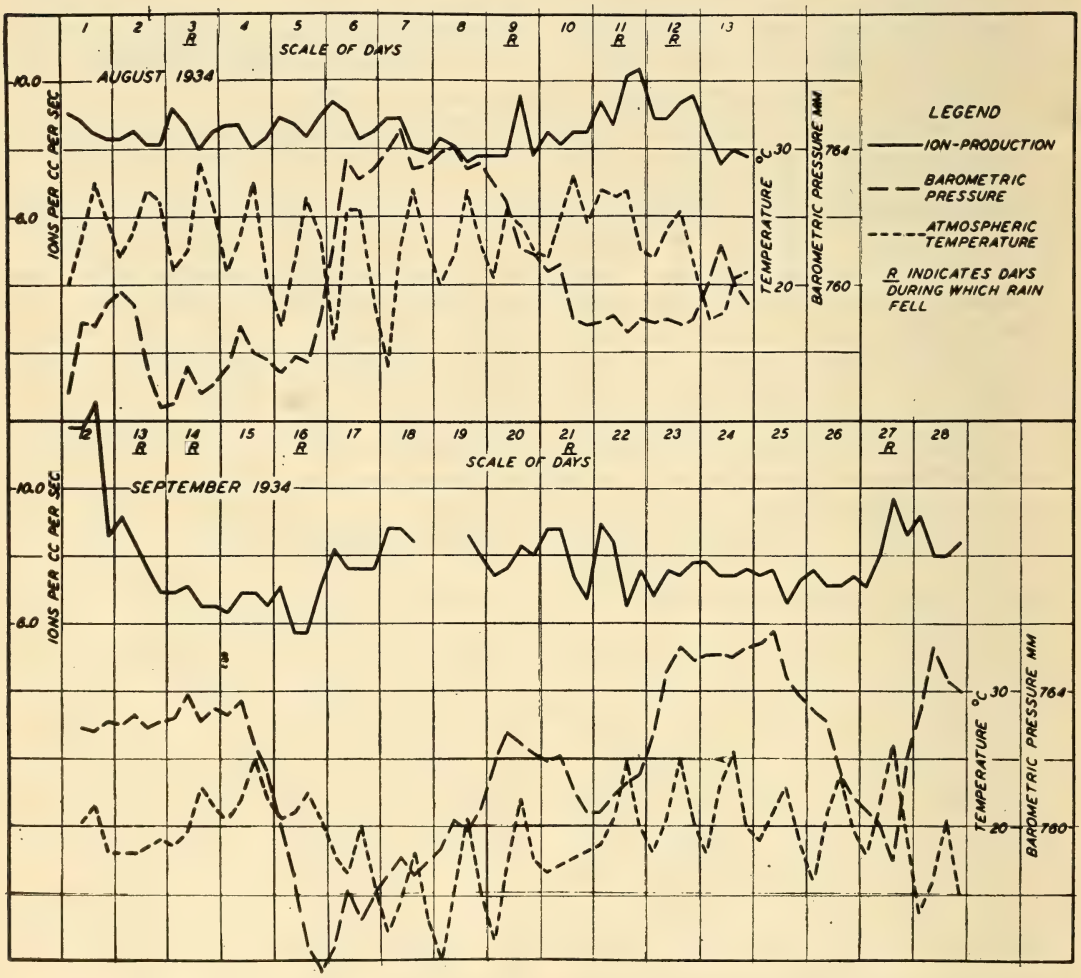


FIG. 15.—Rate of ion-production in closed chamber and meteorological conditions—means 6-hour intervals at Washington, D. C.

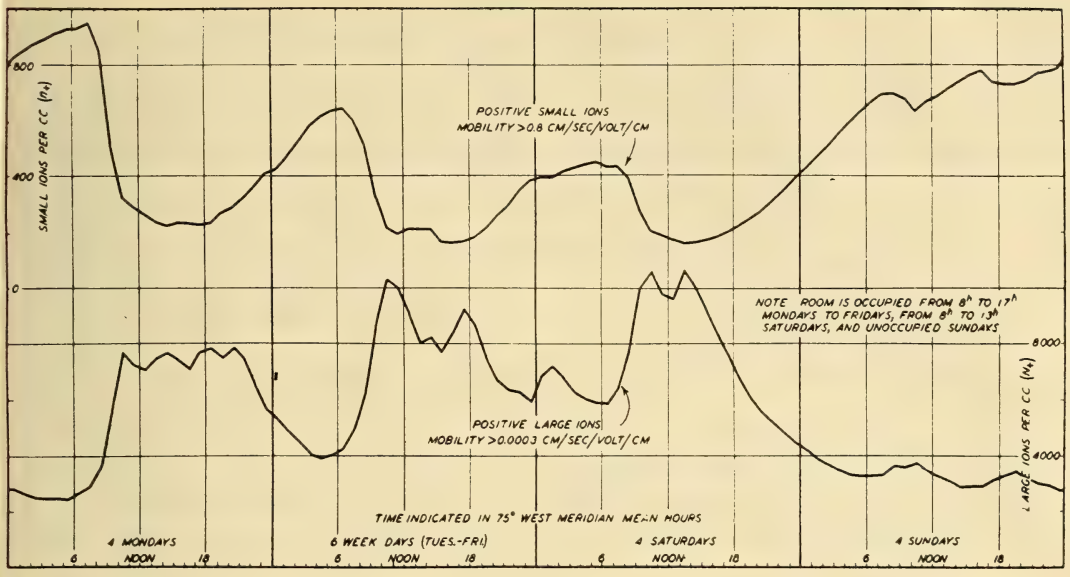


FIG. 16.—Effect of occupancy on numbers of small and of large ions inside room 210 in main laboratory, Department Terrestrial Magnetism, Washington, D. C., November 17 to December 7, 1933.

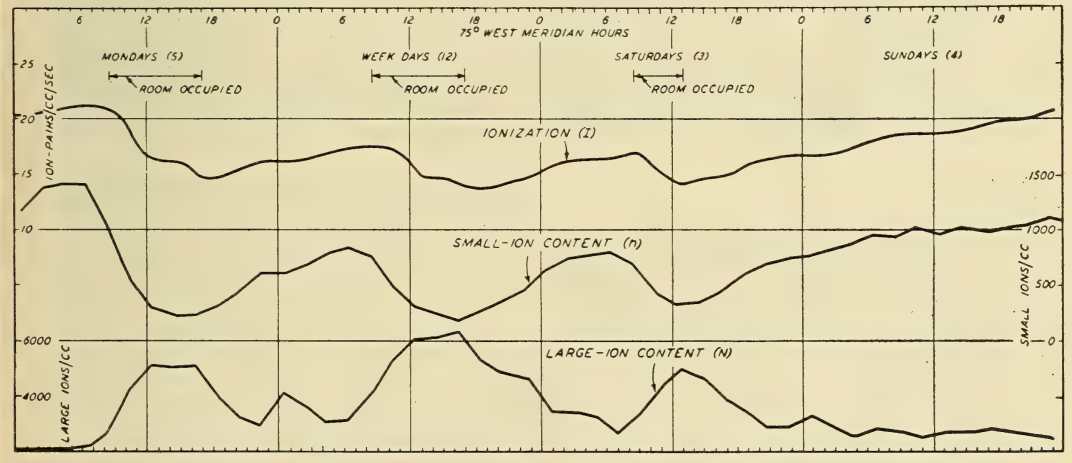


FIG. 17.—Ionization, small-ion content and large-ion content in room 211, Department of Terrestrial Magnetism, February 1938.

ity of which are probably electrically charged and nearly equally divided between the two signs. Incidentally, the presence of these particles makes it possible for us to see our breath on a cold day (to use the popular expression) because the particles act as condensation nuclei.

Upon measuring the ionization with a thin-walled chamber inside our laboratory room it was found that this element also underwent a diurnal variation suggestive of an effect due to people occupying the building. In Fig. 17 are shown diurnal variation curves for this element and those for the small- and large-ion content of the air. The days are grouped to provide curves for Mondays, Saturdays, other week days, and Sundays. From these curves it is seen that the ionization varies in a manner similar to that of the small-ion content. In one ex-

periment a thick-walled chamber (of sufficient thickness to stop all alpha radiation from the radioactive matter) was used, and very little change in ionization occurred. In another an extremely thin-walled chamber was employed and a large diurnal variation in ionization was observed. A comparison, using data for week days, of ionization in the thick-walled and a very thin-walled chamber, is shown in Fig. 18. Their differences are also plotted as a diurnal variation curve. This shows how the

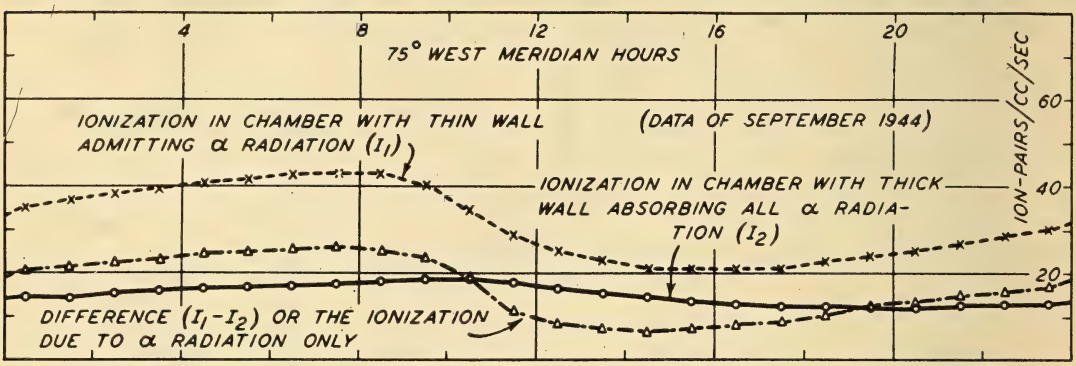


FIG. 18.—Ionization measurements in closed laboratory room of building occupied by people only during work hours.

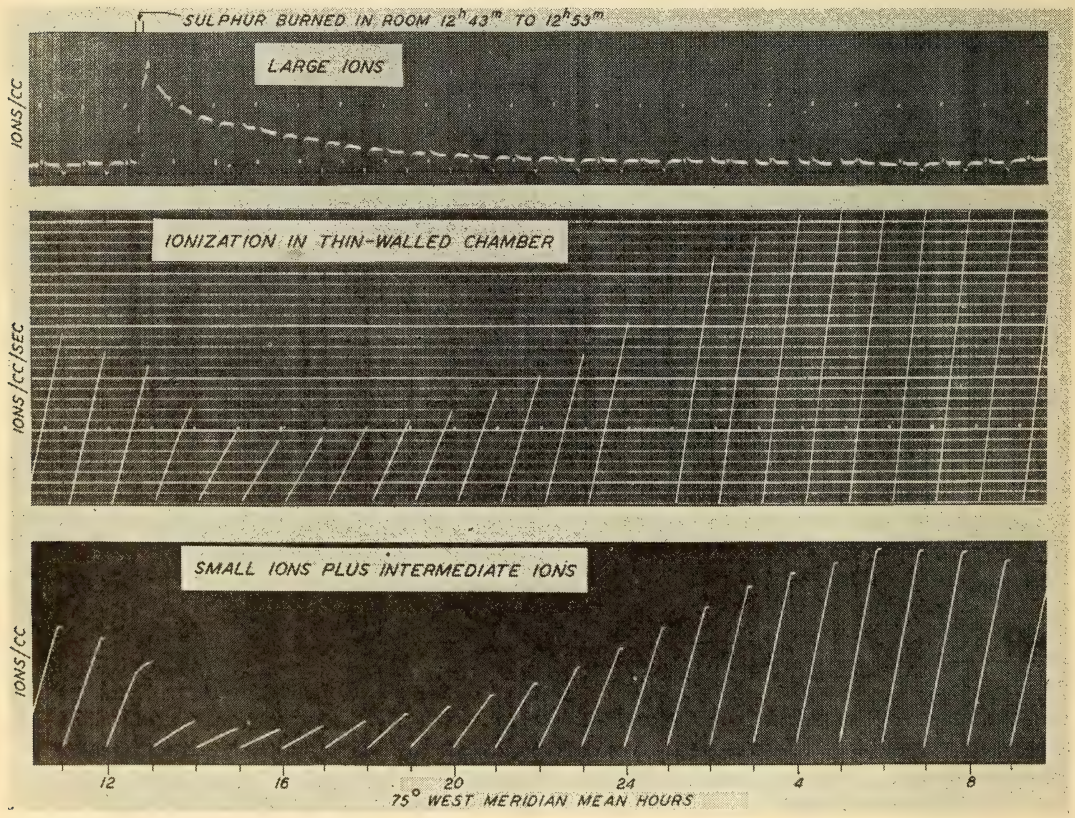
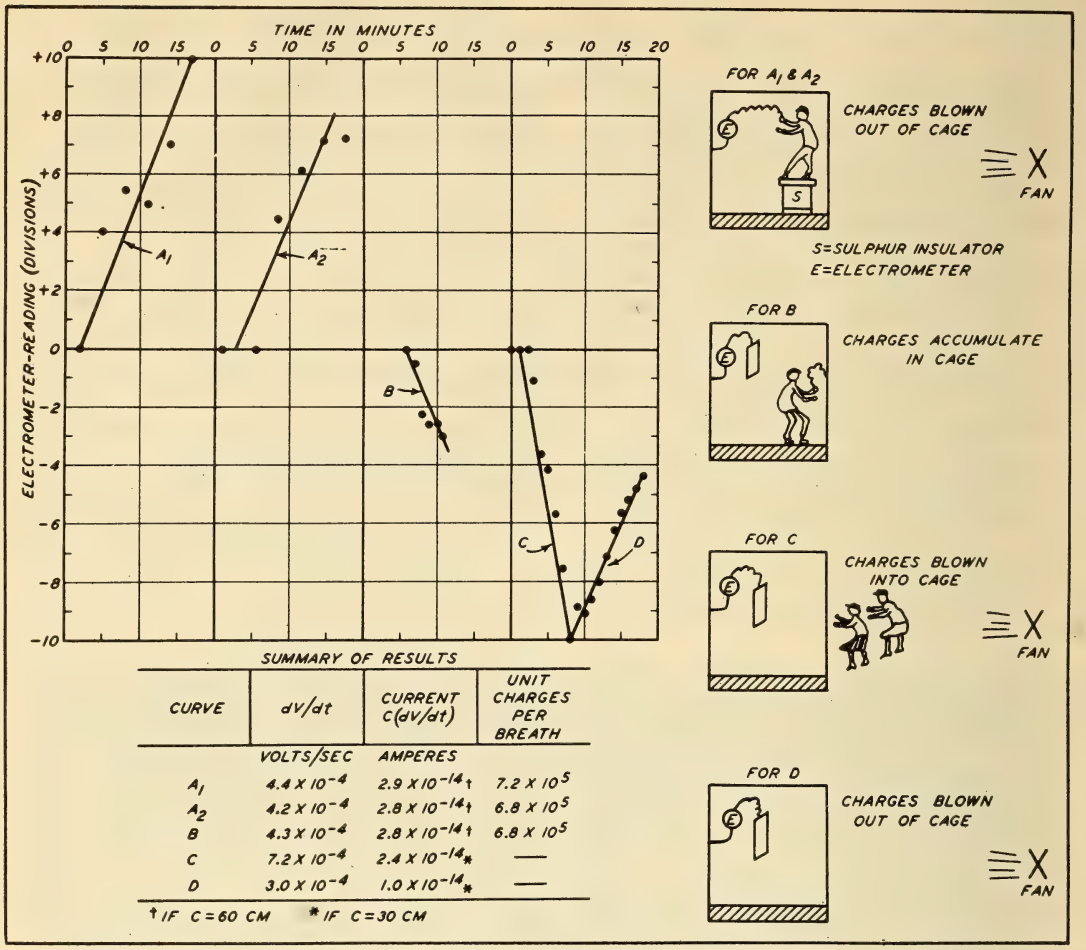


FIG. 19.—Records in closed room showing effect of burning sulphur on large ions, ionization in thin-walled chamber, and small ions plus intermediate ions, March 19–20, 1934 (potential of ionization-chamber negative with respect to earth).

alpha-ray ionization varies. The variation of beta and gamma ray ionization through the day is presented in the curve for the thick-walled chamber. These results suggest that the radioactive materials, particularly those giving off alpha radiation, gradually disappear from the air when the building is occupied by people. This is interpreted to mean that particles, smoke-particles and those exhaled in the breath, act in some manner to reduce the amount of radon in the air. In any case, if such particles are the fundamental cause of the observed reduction in the ionization of the air, a test should reveal this fact. Records of the ionization of the small-ion and of the large-ion content of the air of a room before, during, and after the introduction of smoke, are shown in Fig. 19. These are clear indications that smoke does reduce the ionization of the air as measured with a thin-walled chamber.

There seems to be no simple way of accounting for a reduced amount of radon in the air resulting from the introduction of smoke or other particles. Air containing a large number of these particles has an increased stopping power for alpha radiation. Calculation clearly indicates, however, that this effect is small and can not account for the change in ionization as observed. The agglomeration of particles and the adherence of radioactive matter to them increases the rate at which they fall out of the air. It is impossible to reject entirely this explanation. Preliminary tests, however, make it appear unlikely that radioactive material is removed from the air in this way. Other possible ways of accounting for the observed results might be suggested. One might, for example, point to the increased tendency for radioactive matter to cling to solid objects particularly when associated with electrically charged particles in the air. However, if radioactive matter clings to both the cellophane-covered chamber and the walls of the room without distinction, one would expect a resulting increase and not a decrease in the measured ionization of the air. At present no attempt will be made to explain observed results. It is hoped that additional experiments may be carried out to assist in the solution of this problem.

A summary of the results of an experiment that has been found of interest is shown in Fig. 20. The experiment was designed to determine whether an equal number of positive and negative electric charges are given off in the human breath. If the breath contains more charges of one sign than of the other, the body must retain the sign of charge not given off and consequently have a tendency to assume a charge. If appropriate means are used it is possible to measure this charging process and also to test the breath for any charge that may be present. Such tests have been carried out using a large Faraday cage composed of copper-wire screen in the form of a cube. A human subject was put into the cage and insulated electrically from it, his wrist being connected electrically, using a cloth moistened with a salt solution, to the fiber system of a single-fiber electrometer. The electrometer was placed inside and its outside case connected to the cage. As seen from the curve, the electrometer fiber gradually drifted in a direction which indicated that the subject was receiving, or in this instance was retaining, a positive charge. A second subject gave the same results and essentially the same rate of charging which corresponded to a current of about 10^{-14} amperes. If the human system retains a positive charge, it must give off a negative charge. In a second experiment an arrangement permitted the charge retained by the body to pass to the cage and thence to ground, while any charge in the breath remained inside the cage. With the electrometer fiber now connected to an insulated plate the electrometer through induction will show a response to the charged breath of the same direction as if this sign of charge were applied directly to the fiber system. In this experiment the electrometer fiber drifted in a direction indicating that a negative charge was accumulating in the cage as was to be expected. The rate of drift, considering the relative capacities of the system in the two instances, was quantitatively of the right amount to agree with that found in the



SUMMARY OF RESULTS

CURVE	dV/dt	CURRENT C(dV/dt)	UNIT CHARGES PER BREATH
	VOLTS/SEC	AMPERES	
A_1	4.4×10^{-4}	2.9×10^{-14} †	7.2×10^{5}
A_2	4.2×10^{-4}	2.8×10^{-14} †	6.8×10^{5}
B	4.3×10^{-4}	2.8×10^{-14} †	6.8×10^{5}
C	7.2×10^{-4}	2.4×10^{-14} *	—
D	3.0×10^{-4}	1.0×10^{-14} *	—

† IF C = 60 CM * IF C = 30 CM

FIG. 20.—Experiments demonstrating that people exhale negative and retain positive charges.

first experiment. On the assumption that the human breath contains a negative space-charge, then it was deemed possible to obtain the effect by placing the subject outside the cage and blowing the charges into the cage with an electric fan. Two subjects were so placed and a fan so situated that their breaths would be gently blown into the cage. The gradual drift of the electrometer fiber again indicated that the breath is negatively charged, and that the quantitative agreement with the previous tests is good. The subjects were suddenly removed from the vicinity of the cage while the fan continued to blow as before. The electrometer fiber drifted back toward zero, thus indicating that the space-charge was gradually removed from the cage, as was to be expected. Additional tests were made and some repeated, all showing the same general results. The above results indicate that each breath contains about 700,000 more negative than positive charges. From other tests, which I am unable to discuss at this time, it is estimated that each breath contains around a thousand times this number of each sign. That is to say, in a thousand positive charges given off in the breath, there will, on the average, be one thousand and one negative charges given off. The whole field of breath particles is almost entirely unexplored, and one can only hope that some day it may be more adequately investigated.

SUMMARY

1. To understand why the conductivity of the lower atmosphere varies so greatly with season, through the day, and from station to station, and even in going from city to rural community nearby, it is necessary to understand why the number of small ions varies under those conditions.

2. The number of small ions per cc for equilibrium-conditions depends on two factors—the rate of production and the rate of destruction. The rate of destruction in a locality where there are many condensation nuclei is proportional to the sum of two terms, one containing the number of nuclei per cc and the other approximately a constant for a given time and place.

3. Contributing toward the production of small ions are the cosmic rays and the radioactive material in the soil and air. The amount of radioactive material in the outside air is subject to considerable variation. A blanket of snow and a moist soil reduce the amount of radioactive gas escaping from the soil, and consequently the amount in the atmosphere.

4. An important diurnal variation in the rate of production of small ions occurs. A maximum rate occurs due probably to an accumulation in the air of radioactive matter during the night and the early morning hours. This is probably an important contribution to the early morning maximum in conductivity of the air noted in all the diurnal variation curves shown. The rate of production begins to decline as increased mixing of the air sets in later in the day.

5. The decrease in conductivity of the air during smoky conditions as compared with nonsmoky conditions, shown from the Watheroo data, is due to the destructive effect of smoke particles on the small ions. Likewise, the decreased conductivity in Washington as compared with that in the country districts is largely due to the accumulation in the city of smoke and gases from automobiles, domestic fires, etc., and the destructive effects that the particles in the smoke and gases have upon the small ions.

6. The gradual reduction in conductivity of the air over the ocean is probably due to the gradual accumulation through the years of smoke and gases from ocean-going vessels. It is also possible that some accumulation occurs because of industrial fires on nearby continents.

Thus we see that, like a living thing, the conductivity of the lower atmosphere finds survival increasingly difficult in our modern industrial age. Civilization is taking its toll of this as it is of the many more tangible things.

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PALEOBOTANY.—*Alterations in some fossil and living floras.*[1] ROLAND W. BROWN, U. S. Geological Survey.

Since my last roundup of changes in fossil floras new specimens and new information have appeared and now warrant another statement. Such periodic overhaulings seem to me essential to the progress of paleobotany because they concentrate attention on the weak spots, invite discussion, and stimulate more precise work before publication. Sometimes these revisions find little favor. Thus, E. W. Berry objected (*9*)[2] to some changes I proposed (*18*) in the Eocene Wilcox flora of the Gulf States on the alleged ground that they were unsubstantiated by facts and that his overspeciation was justified by the principle that in the study of a fossil flora "it is a sound method for a refined analysis to precede an attempted synthesis." Space does not permit a detailed reply to these criticisms. In part, however, I herewith submit two new species, *Betula taylorana* and *Comptonia mississippiana*, in support of my opinion that the Wilcox flora contains scattered remains of temperate species.

Although the changes here suggested involve miscellaneous floras, particular attention focuses on the flora of the Latah (Miocene) and related formations in Washington and Idaho. The Miocene collections of the United States National Museum have grown steadily as a result of the generous cooperation of local collectors such as E. E. Alexander, C. O. Fernquist, and Kenneth Buxton, of Spokane, Wash., and Boyd Olson, of Orofino, Idaho. In 1941 I visited many of the Washington and Idaho localities and obtained significant new material, particularly diagnostic fruits and seeds; and in 1943 I. G. Sohn, also of the U. S. Geological Survey, obtained a collection in the Latah formation near Elk River, Idaho. Late in 1945 the Johns Hopkins University deposited in the National Museum all its Mesozoic and Cenozoic plant collections. These include many specimens from South American localities.

Many of the changes here proposed have been projected as a result of consultation with Dr. Daniel I. Axelrod, whose friendly criticism and intelligent collaboration are gratefully acknowledged. He, however, is not to be held responsible for any errors I may have perpetrated.

TROCHILISCACEAE

Trochiliscus greenei (Ulrich) Brown, n. comb.
Moellerina greenei Ulrich (*48*), p. 34, pl. 3, figs. 8, 8a-8e.
Trochiliscus devonicus (Wieland) Peck (*44*), p. 108, pl. 12, figs. 14–21. See synonymy.

In Peck's review of North American Charophyta he discussed *Moellerina greenei* described by E. O. Ulrich as a foraminifer from the Onondaga limestone (Devonian) at the Falls of the Ohio, near Jeffersonville, Ind., and Louisville, Ky. Peck copied (*44*, pl. 9, figs. 2a–2f) Ulrich's figures and pointed out that the spirals of the specimens as figured are sinistral, the only known exception to the rule that the spirals of all pre-Pennsylvanian trochiliscids are dextral. For this reason Peck suspected that the original figures may have been reversed and, as the Ulrich types were thought to be lost, he refrained from using the Ulrich name. The types, however, are not lost but are preserved in the United States National Museum. The spirals are dextral. Dr. Ulrich explained to me on May 8, 1940, that the sinistral spirals were an inadvertence, he having drawn the illustrations by camera lucida directly on lithographic stone. Consequently, in printing, a reversed image of the original resulted.

I see no difference between Ulrich's *Moellerina greenei* and Peck's *Trochiliscus devonicus*, founded on a record and name only by G. R. Wieland, and specimens subsequently collected by Peck at Wieland's locality.

Occurrence: Devonian. Onondaga limestone. Falls of the Ohio, near Jeffersonville, Ind., and Louisville, Ky.

PINACEAE

Pseudolarix bienensis (Hu and Chaney) Brown, n. comb.
Cedrela bienensis Hu and Cheney (*28*), p. 54, pl.

[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior. Received June 28, 1946.

[2] Italic numbers in parentheses refer to the Literature Cited.

30, fig. 3 [not fig. 2, which is *Rhus miosuccedanea* Hu and Chaney].

This winged seed lacks the distinguishing features of *Cedrela* seeds but resembles closely those of the conifers *Keteleeria* and *Pseudolarix*. As the nutlet is rounded rather than triangular and only about one-fourth the total length of the seed I consider that the seed represents *Pseudolarix*. The true identity of this seed necessitates a modification of the statement by Hu and Chaney (pp. 6, 109) that "the Shanwang flora as now known is made up exclusively of angiosperms."

Occurrence: This species is an item in a large flora from an outcrop of laminated Miocene shale, called by the Chinese "the book of ten thousand volumes," near Shanwang in Shantung Province, China.

SALICACEAE

Populus lindgreni Knowlton Fig. 12

Populus lindgreni Knowlton (*29*), p. 725, pl. 100, fig. 3.

Although several species of *Populus* were reported in the first papers on the Latah flora, the specimens subsequently proved assignable to other genera. In recently acquired material, however, there are several authentic examples of *Populus lindgreni* Knowlton, which was described originally from the Payette formation of Idaho, now believed to be synchronous, or nearly so, with the Latah formation.

Occurrence: Miocene. Latah formation. Vera, Wash. (Fig. 12); collected by C. O. Fernquist. East of Orofino, Idaho; collected by Boyd Olson.

MYRICACEAE

Comptonia mississippiana Brown, n. sp. Fig. 9

Leaves as in the living sweetfern, *Comptonia peregrina* (Linnaeus) Coulter, except that the lobes are more acute and in many instances are deeply toothed. Judged by the numerous described species of *Comptonia* the genus was widely distributed in the North Temperate Zone during the Tertiary, but only one species survives and that occupies relatively dry hillsides and open woodland borders from Michigan to Nova Scotia and south to Tennessee.

Occurrence: Eocene. In bauxite-bearing strata low in the Wilcox formation in sec. 36, T. 3 S., R. 2. E., Tippah County, Miss.; collected by Louis C. Conant.

BETULACEAE

Betula taylorana Brown, n. sp. Fig. 14

Leaves 8–15 cm long, acuminate, rounded at the base, with double-serrate margins, the teeth of nearly uniform size, rounded to acute. Secondary veins slightly spreading, straight, or gently curved, the basal pairs branched. Petiole 5–10 mm long. Seven fragments represent this species, which, except for the rounded base, resembles the yellow birch, *Betula lutea* Michaux, of moist uplands and stream banks in eastern North America south to North Carolina and Tennessee.

Occurrence: Eocene. Ackerman formation. Jim Taylor farm in Chester County, 4 miles northwest of Silerton, Hardeman County, Tenn.; collected by F. S. MacNeil.

FAGACEAE

Quercus axelrodi Brown, n. sp. Fig. 13

Leaf oblong-lanceolate to narrowly elliptic. On several smaller specimens the apex is acute and base cuneate to somewhat rounded. Margin entire in basal quarter of the blade, but evenly toothed distad with large, rounded, slightly hooked, blunt-tipped teeth directed toward the apex. Sinuses between the teeth relatively shallow and scalloped. Secondary veins evenly spaced and fairly straight in upper half of the blade, somewhat irregular and spreading in the lower half.

Although these leaves might be compared casually with those of the chestnut oak, *Quercus montana* Willdenow, their sharper, hooked teeth point toward closer comparison with those of the chinquapin oak, *Q. muhlenbergi* Engelmann. The latter species is comparatively rare in the Atlantic States but abundant in the Mississippi Basin.

I name this species for Dr. Daniel I. Axelrod, who has been assiduous in the study of the late Tertiary floras of California and adjoining States.

Occurrence: Miocene. Latah formation. Vera Wash. (Fig. 13); collected by R. W. Brown. Brickyard locality, Spokane, Wash.

ULMACEAE

Zelkova drymeja (Lesquereux) Brown, n. comb.

Rhus? drymeja Lesquereux (*36*), p. 416.

Myrica drymeja (Lesquereux) Knowlton (*32*), p. 394. [Exclude item Knowlton, 1916, p. 256, pl. 20, figs. 1, 2.]

Callicoma microphylla Ettingshausen. Lesquereux (*37*), p. 246, pl. 43, figs. 2–4.
Myrica callicomaefolia Lesquereux (*39*), p. 146, pl. 26, figs. 5–14.
Myrica fallax Lesquereux (*39*), p. 147, pl. 32, figs. 11–14 [not figs. 15, 16].
Ulmus brownellii Lesquereux (*39*), p. 160, pl. 28, figs. 2, 4.
Fagopsis longifolia (Lesquereux) Hollick. Knowlton (*31*), p. 265, pl. 20, fig. 5.

The leaves included in the foregoing synonymy are in general asymmetric, linear-lanceolate in outline, with acute to attenuate apices, and evenly serrate margins, the teeth being single, sharp triangular, and only rarely somewhat rounded to mammillate. The large suite in the Florissant collection of the U. S. National Museum contains no broad-ovate specimens with large round-mammillate teeth. Consequently, I conclude this species differs from *Zelkova hesperia* particularly in this feature and from *Z. nervosa* in having leaves that are more lanceolate in outline.

Occurrence: Oligocene. Lake beds at Florissant, Colo.

Zelkova hesperia Brown, n. sp. Fig. 3

Ulmus brownellii Lesquereux. Chaney (*21*), p. 113, pl. 12, figs. 3, 6, 7, 8; pl. 13, figs. 1, 3, 6. [Exclude the synonymy.]

As the types of *Ulmus brownellii* Lesquereux from Florissant, Colo., are herein referred to *Zelkova drymeja* (Lesquereux) Brown, the species from the Crooked River region of Oregon, being regarded as different, requires a new specific name.

The leaves of this species display considerable variation in outline and dentition. They are more or less asymmetric, tend to be ovate-lanceolate in form, with acute to blunt apices, and evenly serrate margins, the teeth being single, sharp-angular in some instances but rounded-mammillate in others, as in the figured specimen.

This species was originally compared with *Ulmus parvifolia* Jacquin, but the latter, although admittedly bearing some single-serrate leaves, has preponderantly double-serrate foliage. I have never seen a double-serrate leaf in *Zelkova hesperia*, though this could be possible, as it is rarely in the living species of *Zelkova*. However, the regular, slightly curving, but unbranched secondaries, with an exceptional secondary forking near the midrib, and the clear-cut regularity of the teeth, are features that distinguish these leaves as *Zelkova* and remove them from *Ulmus*.

The species differs from *Zelkova drymeja* at Florissant, Colo., chiefly in having broader variants among its leaves and in the teeth being more conspicuously rounded.

Occurrence: Oligocene. Gray Ranch (now McCullough), 11 miles east of Post, on Crooked River, Oreg.; collected by R. W. Brown.

Zelkova nervosa (Newberry) Brown, n. comb.

Planera nervosa Newberry (*42*), p. 508; *43*, p. 83, pl. 67, figs. 2, 3; Brown (*10*), p. 284, pl. 71, figs. 7–9; Brown (*11*), p. 56. [See synonymy.]
Myrica minuta Knowlton (*33*), p. 157, pl. 37, fig. 12; Brown (*11*), p. 54, pl. 9, figs. 1, 2. [See synonymy.]

In my discussions of the species here synonymized I referred to the possibility of their being *Zelkova*. Recent collections have yielded additional twigs bearing characteristic leaves and fruits that confirm the validity of the transfer to *Zelkova*.

These leaves are in general only slightly asymmetric, with occasional conspicuous exceptions. They are linear-ovate to elliptic in outline, the widest portion of the blade being at or just below the midpoint of the midrib. The teeth are single, serrate, sharp or rounded, receiving the slightly curved, unbranched secondary veins.

This species differs from *Zelkova drymeja* and *Z. hesperia* chiefly in having foliage that is notably more elliptic in outline.

Occurrence: Eocene. Green River formation. At numerous localities in Colorado.

Zelkova ungeri Kovats

Zelkova ungeri Kovats. Hu and Chaney (*28*), p. 41, pl. 15, figs. 1, 3, 4; pl. 16, figs. 1, 3.
Carpinus mioturczaninowii Hu and Chaney (*28*), p. 33, pl. 9, fig. 2 [not other figures].
Acer miohenryi Hu and Chaney (*28*), p. 59, pl. 33, fig. 3c; pl. 34, fig. 2; pl. 35, fig. 2 [not other figures].

The large, rounded, mammillate, simple teeth, the generally unbranched secondaries, but with occasional forks starting well in toward the midrib, identify these leaves as *Zelkova*. They can be matched from almost any tree of *Zelkova serrata* Maximowicz.

Occurrence: Miocene. Shanwang, China.



FIGS. 1, 2.—*Koelreuteria mixta* (Lesquereux) Brown, n. comb. FIG. 3.—*Zelkova hesperia* Brown, n. sp. FIGS. 4–6.—*Exbucklandia oregonensis* (Chaney) Brown, n. comb. FIGS. 7, 8.—Seeds of *Liquidambar* sp. FIG. 9.—*Comptonia mississippiana* Brown, n. sp. FIG. 10.—*Halesia columbiana* Brown, n. sp. FIG. 11.—*Mahonia simplex* (Newberry) Arnold. FIG. 12.—*Populus lindgreni* Knowlton. FIG. 13.—*Quercus axelrodi* Brown, n. sp. FIG. 14.—*Betula taylorana* Brown, n. sp. FIG. 15.—*Rhododendron chaneyi* Brown, n. sp. All figures natural size.

BERBERIDACEAE

Mahonia simplex (Newberry) Arnold
Fig. 11

Mahonia simplex (Newberry) Arnold (*1*), p. 58, pl. 1, figs. 1–3, 6–7; pl. 2, figs. 1–2.

A small, fragmentary leaflet, bearing only the terminal and one lateral, sharp-pointed lobe, apparently represents this species, the first time to be reported from the Latah formation.

Occurrence: Miocene. Latah formation. Near Elk River, Idaho; collected by I. G. Sohn.

LAURACEAE

Persea lanceolata (Berry) Brown, n. comb.

Laurus similis Knowlton (*34*), p. 41, pl. 23, figs., 4, 5, 6; pl. 24, fig. 2; Berry (*4*) p. 259, pl. 58, fig. 2; Brown (*13*), p. 174.
Umbellularia lanceolata Berry (*4*), p. 260, pl. 59, fig. 1.

In 1937 I intimated that these leaves from the Latah formation might belong to *Persea*. Further consideration leads me now to make the transfer. The leaves originally described by Knowlton from Comstock, Oreg., as *Laurus similis* were transferred by Sanborn to *Persea pseudocarolinensis* Lesquereux, which was described from Middle Eocene deposits near Colfax, Calif. Potbury also identified the latter species at La Porte, Calif., in deposits of late Eocene or early Oligocene age.

These leaves do not represent *Umbellularia*, because they lack the characteristic, although sometimes obscure, paired basal veins (incipient primaries) seen on the leaves of that genus. Considerable variety is displayed by the Latah leaves, but the dominant forms appear to be relatively long and narrow. They resemble the leaves of the living redbay, *Persea borbonia* (Linnaeus) Sprengel, of the southeastern States.

Occurrence: Miocene. Latah formation. Spokane, Wash.

HAMAMELIDACEAE

Exbucklandia Roland W. Brown, n. name
(for *Bucklandia* Robert Brown)

In 1825 the name *Bucklandia* was published in the *Tentamen* of Sternberg's *Flora der Vorwelt* to include fossil stems of cycadeoid affinity. The authorship of the name has been attributed to both Presl and Sternberg, but this is now immaterial. In 1832 Robert Brown used the name *Bucklandia* for a genus of the witchhazel family, Hamamelidaceae, represented by one species, *B. populnea*, a tall tree of the eastern Himalayas and the mountainous areas of southern China. Inasmuch as the 1825 cycadeoid name has priority, the witchhazel genus requires a new name. For this I propose *Exbucklandia*, the derivation of which is obvious. The single species becomes *Exbucklandia populnea* (Robert Brown) Roland W. Brown.

Exbucklandia oregonensis (Chaney) Brown, n. comb. Figs. 4–6

Cercis oregonensis Chaney (*19*), p. 177, pl. 16, figs. 3, 4.
Ficus? washingtonensis Knowlton (*34*), p. 40, pl. 25; pl. 26, figs. 1–3.
Meibomites lucens Knowlton (*34*), p. 44, pl. 28, fig. 10.
Meibomites knowltoni Berry (*4*), p. 253, pl. 56, fig. 7.
Cercis spokanensis Knowlton. Brown (*13*), p. 177, pl. 54, figs. 8, 9 [not other figures].

In 1937 I considered that the leaves from the Latah formation described by Knowlton as *Ficus? washingtonensis* and the pods he called *Cercis spokanensis* were produced by the same species of plant. This opinion was based on the somewhat swollen appearance of the top of the petiole at the base of the blade, which is a feature common to most leguminous leaves and leaflets. Recently, however, at the suggestion of Dr. D. I. Axelrod, I compared the leaves with those of *Exbucklandia populnea* (Robert Brown) Roland W. Brown, a hamamelidaceous species inhabitating the mountainous areas of Kwangsi, Kwantung, and Yunnan, China, at elevations of 5,000 feet, more or less. The similarity in outline, even to the occasional pointed lobes, in venation, in texture, and in the somewhat alate top of the petiole, were so striking that I looked for confirmation of the identification among the fruits and seeds in the Latah collections where I found the fruit and seed here illustrated. Similar associated leaves and fruits occur on Layng Creek near Rujada, Oreg. The fruits are heads, 1.5–2 cm in diameter, composed of five or more perfect and several aborted capsules. The peduncles are relatively slender as compared with those of *Exbucklandia populnea*. The seed, which superficially resembles those of *Liquidambar* but is twice as large, is winged, the nutlet being obliquely set, of about the same length as the wing, rounded at the proximal end and sharp-pointed at the distal end, thus presenting a somewhat triangular appearance. The wing is not divided lengthwise

by a conspicuous line or vein as in *Liquidambar*, but this feature may be obscure or absent in fossil seeds of *Liquidambar*, as illustrated in Figs. 7, 8.

This disposition of the foliage of *Cercis oregonensis* Chaney and *Ficus? washingtonensis* Knowlton leaves the pods called *Cercis spokanensis* Knowlton as originally described but does not explain their affinity. They appear to be too large, thick, and blunt for acceptance as *Cercis*. Somewhat similar and perhaps identical pods were described from Bridgeton, N. J., by Hollick (*26*, p. 49) as *Mezoneurum bridgetonense* (pl. 258, figs. 1–7) and *Lonchocarpus novaecaesareae* (pl. 259, figs. 6–8). These two species are, in my opinion, a single species, but whether they are referable to either *Mezoneurum* or *Lonchocarpus* remains to be determined. Hollick tentatively regarded the Bridgeton deposits as late Tertiary or Pleistocene. The Latah pods may be related to the foliage now called *Sophora spokanensis* Knowlton, but the latter may be a mixture of several legumes which cannot yet be differentiated.

Occurrence: Miocene. Eagle Creek formation, near Bonneville, Oreg. Latah formation, brickyard locality, Spokane, Wash. (Figs. 4, 5) collected by E. E. Alexander. One mile east of Layng Creek Ranger Station, near Rujada, Oreg. (Fig. 6); collected by R. W. Brown and A. G. Simson.

Rosaceae

Amelanchier couleeana (Berry) Brown, n. comb.

Phyllites couleeanus Berry (*6*), p. 42, pl. 13, fig. 12.
Amelanchier scudderi Cockerell. Berry (*4*), p. 252, pl. 55, fig. 4.
Amelanchier grayi Chaney. MacGinitie (*40*), p. 58.
Amelanchier magnifolia Arnold (*2*), p. 89, pl. 4, figs. 1, 4; text figs. 2, 3.
Amelanchier dignatus (Knowlton) Brown (*12*), p. 577 [not pl. 69, figs. 5, 6, which need reidentification]; Brown (*13*), p. 176, pl. 53, fig. 11.
Amelanchier dignata (Knowlton) Smith (*47*), p. 514, pl. 13, fig. 2.
Amelanchier elliptica Smith (*47*), p. 514, pl. 13, fig. 1.
Amelanchier subserrata Smith (*47*), p. 514, pl. 13, fig. 7.

In 1935 I erred in transferring *Celastrus dignatus* Knowlton (*30*, p. 71, pl. 11, fig. 5) to *Amelanchier*, later finding that it is a specimen of *Zelkova oregoniana* (Knowlton) Brown.

Occurrence: Miocene. Grand Coulee, Wash., and other localities in adjacent states.

Fabaceae

Cladrastis oregonensis (Knowlton and Cockerell) Brown, n. comb.

Fraxinus oregonensis Knowlton and Cockerell. Knowlton (*32*), p. 296.
Umbellularia oregonensis (Knowlton and Cockerell) Chaney (*20*), p. 60, pl. 1, figs. 1, 3, 5, 7; Chaney (*21*), p. 117, pl. 14, fig. 2.
Cladrastis oregonensis Brown (*14*), p. 415, fig. 1.

Comparison of the fossil leaves most recently identified as *Umbellularia oregonensis* with similar living leaves of *Umbellularia* shows that the fossils lack a significant feature of most *Umbellularia* leaves, the pair of obscure basal primaries. Furthermore, in the fossils the secondary veins display constant smooth curvation, whereas in *Umbellularia* the secondaries are somewhat irregular, and are almost straight for some distance after emergence from the midrib until they curve upward abruptly toward the adjacent secondary. Finally, the relatively short, thick petioles of the fossils are finely striated transversely, which is an almost infallible indicator of leguminous affinity. The outline, venation, and petiole of these leaves can be matched in leaves of some Asiatic species of *Cladrastis*, particularly *C. platycarpa* (Maximowicz) Makino. As a fossil pod of *Cladrastis* has already been described from the same locality the presumption seems reasonable that the pod and leaves confirm one another. It is further possible that the small fossil pods called *Micropodium ovatum* (Lesquereux) Brown also belong with this species or that the leaves represent two species not readily separable.

Occurrence: Oligocene shales on Bridge Creek and Crooked River, Oreg.

Sapindaceae

Koelreuteria miointegrifoliola Hu and Chaney

Koelreuteria miointegrifoliola Hu and Chaney (*28*), p. 64, pl. 38, fig. 1 [not pl. 38, fig. 3, nor pl. 39, fig. 3 (which is identical with pl. 8, fig. 5), both being referable to a species of Juglandaceae].

Comparison of the leaflets assigned to this species with the leaflet of *Koelreuteria integrifoliola* Merrill (pl. 39, fig. 2), although suggesting some similarities, shows that they differ

in three important particulars: the marginal teeth are sharp serrate-dentate rather than blunt and crenate; they lack petioles; and they have no prominent intersecondaries. The leaflets, therefore, are not referable to *Koelreuteria*, but to one of the juglandaceous species of the same flora.

With the elimination of these leaflets only the capsule now represents *Koelreuteria miointegrifoliola*. Speculation, however, prompts an inspection of the remainder of the flora for possibilities of *Koelreuteria* foliage. Other pinnately compound-leaved species described by Hu and Chaney are: *Ailanthus youngi*, *Cedrela bienensis*, *Pistacia miochinensis*, and *Rhus miosuccedanea*. Of these, *Cedrela bienensis* is removed by transfer (see *Pseudolarix*) to other genera. The leaflets and fragmentary seed (pl. 30, figs. 4, 5, 8, 9), referred to *Ailanthus youngi*, are mixed. The illustration reveals nothing conclusive as to the correct identity of the seed. The leaflet (fig. 4), with its numerous, sharp, serrate teeth, certainly does not represent *Ailanthus*. The remaining leaflets, together with those of *Pistacia miochinensis* and *Rhus miosuccedanea* are, therefore, under suspicion of harboring among their number some that belong to *Koelreuteria*, but without having the actual specimens for comparison with living material I hesitate to make any specific transfers.

Occurrence: Miocene. Shanwang, China.

Koelreuteria reticulata (Ettingshausen) Brown, n. comb.

Dalbergia reticulata Ettingshausen (*23*), p. 37, pl. 4, fig. 5 [not fig. 6, which is *Copaifera longestipitata* Kovats].
Tmesipteris reticulata (Ettingshausen) Hollick (*25*), p. 256.
Phyllites reticulatus (Ettingshausen) Florin (*24*), p. 255.
Ptelea macroptera Kovats (*35*), p. 51, pl. 1, fig. 2.
Koelreuteria macroptera (Kovats) Edwards (*22*), p. 111.

Ettingshausen's specimen is a fragmentary valve without evidence of seeds, but the reticulations are fairly clear. Kovats's specimen is a large, fragmentary valve with the impressions of two rounded seeds, but the reticulations are obscure. As both specimens came from the same strata near Tallya in northeastern Hungary, I see no practical reason for regarding them as different species. Whether this species should also include specimens from the Miocene of Switzerland and Bohemia, erroneously identified by Heer and Brabenec, respectively, as *Salvinia reticulata* (Ettingshausen) Heer, must depend on the finding of better material. What reported leaflets should be assigned to this species is also debatable. Ettingshausen (*23*, p. 36, pl. 2, fig. 10) identified as *Rhus paulliniaefolia* what are apparently the apical three leaflets of a compound leaf. These leaflets came from the same locality as the valves here referred to *Koelreuteria reticulata* and could, by comparison with the leaflets of some living species, have come from a species of *Koelreuteria*. However, caution is indicated because Ettingshausen also reported from the same strata one leaflet referred to *Sapindus falcifolius* Al Braun (p. 33, pl. 4, fig. 1) and another to *S. hazlinskyi* Ettingshausen (p. 33, pl. 4, fig. 2 both of which could also be duplicated from living species of *Koelreuteria*.

Occurrence: Miocene strata near Tallya, Hungary.

Koelreuteria nigricans (Lesquereux) Brown, n. comb.

Myrica nigricans Lesquereux (*37*), p. 132, pl. 17, figs. 9–12.
Rhus nigricans (Lesquereux) Knowlton (*33*), p. 168.
Myrica ludwigii Schimper. Lesquereux (*37*), p. 133, pl. 65, fig. 9.
Myrica undulata? Heer. Lesquereux (*37*), p. 131, pl. 17, figs. 6, 7 [not fig. 8, which remains. It is from Elko, Nev., not Green River, Wyo.]
Myrica alkalina Lesquereux (*39*), p. 149, pl. 45A, figs. 10–15; Brown (*10*), p. 283, pl. 71, figs. 2, 3.
Myrica zachariensis Saporta. Lesquereux (*39*), p. 146, pl. 45A, figs. 6–9 [not pl. 25, fig. 5, which is a Florissant specimen].
Myrica sp. Knowlton (*33*), p. 157, pl. 37, fig. 2.
Planera variabilis Newberry (*43*), p. 83, pl. 66, fig. 7 [not figs. 5, 6].
Rhus variabilis (Newberry) Knowlton (*33*), p. 167; Brown (*11*), p. 59, pl. 11, figs. 1–4.
Rhus myricoides Knowlton (*33*), p. 188, pl. 37, figs. 9–11; Brown (*10*), p. 287, pl. 73, fig. 9.
Comptonia insignis (Lesquereux) Cockerell. Brown (*11*), p. 54.
Staphylea viridifluminis Hollick (*27*), p. 96, pl. 2, fig. 3.
Koelreuteria viridifluminis (Hollick) Brown (*11*), p. 62, pl. 10, fig. 10; Brown (*17*), p. 865, fig. 1 (N, O).

In my previous publications on the flora from the Green River formation I have repeatedly suggested the reference to *Koelreuteria* of most of the species here synonymized. The

aggregation is diverse, but I see no escape, because I find abundant intergradations. The leaflets now assigned to *Koelreuteria nigricans* are distinguished by being petiolulate and generally, but not always, elliptic in outline with the widest part of the blade midway between base and apex, whereas the leaflets of *Rhus* are nearly always sessile with a lanceolate to ovate-lanceolate outline, except in *R. copallina* Linnaeus, whose leaflets may also be elliptic in outline, but the rachis is more or less alate.

The valves of *Koelreuteria nigricans* are elongated elliptical. One figured specimen (Brown, *11*, pl. 10, fig. 10) shows the broad placental flange to which the seed was attached.

Occurrence: Middle Eocene. Green River formation. Numerous localities in Colorado and Wyoming. Lesquereux's locality citation for *Myrica undulata?* Heer (figs. 6, 7) as Elko, Nev., is incorrect and should be "near Green River Station, Wyo."

Koelreuteria mixta (Lesquereux) Brown, n. comb. Figs. 1, 2

Rhus mixta Lesquereux (*38*), p. 30, pl. 9, fig. 13; MacGinitie (*41*), p. 142, pl. 35, figs. 1, 4; pl. 36, fig. 1.

Soon after MacGinitie's study of the Middle Eocene Chalk Bluffs flora of the Sierra Nevada had been published I discovered among the National Museum collections from Independence Hill, Calif., the capsular valve of *Koelreuteria* here figured. It compares in size with the largest of *Koelreuteria alleni* (Lesquereux) Edwards from the lake beds at Florissant, Colo., but the reticulate venation has a tendency toward elongation, whereas in *K. alleni* the reticulations are rather evenly polygonal to squarish. No impressions of seeds are evident.

Although MacGinitie found a favorable comparison between the leaflets of *Rhus mixta* and leaflets of some living species of *Rhus*, there is at least one suspicious difference, namely, that the fossil leaflets are distinctly petiolulate (see MacGinitie's pl. 35, fig. 1; pl. 36, fig. 1), whereas the leaflets of *Rhus* are generally sessile or nearly so. I am therefore swayed to believe that these leaflets represent *Koelreuteria*. Not all the leaflets are toothed, some, as that figured, being entire. These leaflets resemble rather closely some of *Koelreuteria nigricans* (Lesquereux) Brown of the Green River formation in Colorado and Wyoming. MacGinitie synonymized *Astronium oregonum* Chaney and Sanborn with *Rhus mixta*, but I hesitate to do so, inasmuch as no capsules of *Koelreuteria* have been taken, or at least not reported, from the Goshen and Comstock deposits.

Occurrence: Middle Eocene strata at You Bet (Fig. 2) and Independence Hill (Fig. 1), near Colfax, Calif.; collected by R. W. Brown and Cooper Curtice, respectively.

STYRACACEAE

Halesia columbiana Brown, n. sp. Fig. 10

Fruit 3 cm long, two-winged, oblong in outline, tipped by the blunt remains of the style. Peduncle broken. This fruit resembles closely those of the silverbell tree, *Halesia diptera* Ellis. The latter is a small tree that inhabits wet woods and borders of swamps in the southeastern United States. I have seen no leaves in the Latah collections that could be assigned beyond doubt to this species.

Occurrence: Miocene. Latah formation. Brickyard locality, Spokane, Wash.; collected by R. W. Brown.

ERICACEAE

Gaultheria pacifica Brown, n. sp.

Arbutus matthesi Chaney. Brown (*13*), p. 184, pl. 59, figs. 5, 6 [not fig. 1, which is transferred to *A. idahoensis* (Knowlton) Brown].

Soon after I identified these leaves from the Latah formation as *Arbutus matthesi* Chaney, originally described from Oligocene strata on Crooked River, Oreg., I realized that I had made a mistake. They compare much more favorably with the leaves of *Gaultheria* than with those of *Arbutus*. The few, widely spaced, long, looped secondaries that curve upward toward the acute apex, the numerous, minute sharp, serrate, marginal teeth, and the rounded to cordate bases are notable identifying features. Among the 90 species of *Gaultheria* whose distribution is in the warmer regions of the Americas, Asia, and Australia, the closest living match for the fossils seems to be *G. shallon* Pursh, of the Pacific coastal region. The presence of *G. pacifica* in the Latah flora, as judged by the climatic requirements of *G. shallon*, emphasizes the relatively mild, moist character of the Latah environment. This species appears to be the first recognized fossil *Gaultheria* from the Western Hemisphere. Several species based,

in my opinion, on somewhat dubious evidence, as judged by the illustrations, have been described from European localities.

Occurrence: Miocene. Latah formation, Brickyard locality, Spokane, Wash.

Rhododendron chaneyi Brown, n. sp.
Fig. 15

Leaves 15–20 cm long, lanceolate to elliptic in outline, with cuneate to rounded base, the form of the apex being unknown. Margin entire, heavy. Petiole 3.5 cm long, stout. Midrib stout, straight to slightly curved; secondaries evenly spaced, camptodrome, smooth to somewhat irregular, with short intersecondaries. Five incomplete specimens represent this species.

These leaves are smaller, slenderer, less oblanceolate in outline, and thinner in texture than the leaves of *Rhododendron maximum* Linnaeus of eastern North America. The species, however, was probably adapted to climatic conditions similar to those under which the latter thrives. Most of the fossil rhododendrons so far described from North America leave considerable to be desired as regards convincing identity. Probably all can be referred readily to other genera.

I name this species for Dr. Ralph W. Chaney, who has contributed much to the progress of paleobotany in the United States.

Occurrence: Oligocene. About 11 miles east of Post, on Crooked River, Oreg., collected by R. W. Brown.

ADDITIONAL CHANGES

Arbutus matthesi Chaney. Brown (*13*, p. 184, pl. 59, fig. 1) = *Arbutus idahoensis* (Knowlton) Brown.

Arisaema hesperia Knowlton (*34*), p. 29, pl. 10, fig. 1 = *Liquidambar pachyphyllum* Knowlton. This specimen is a much worn sweetgum fruit as can be seen by comparison with the better preserved specimen (Fig. 10) shown on the same plate but identified by Knowlton as *Liquidambar*.

Cebatha heteromorpha (Knowlton) Berry (*6*), p. 37 = *Cocculus heteromorpha* (Knowlton) Brown, n. comb. *Cocculus* is the currently accepted name for this genus.

Cedrela bienensis Hu and Chaney (*28*), p. 54, pl. 30, fig. 2 = *Rhus miosuccedanea* Hu and Chaney.

Cedrela? pteriformis (Berry) Brown. Smith (*47*), p. 516, pl. 14, fig. 2 = *Quercus simulata* Knowlton.

Celastrus dignatus Knowlton (*30*), p. 71, pl. 11, fig. 5 = *Zelkova oregoniana* (Knowlton) Brown.

Cercocarpus praeledifolius Berry. Brown (*13*), p. 177, pl. 56, fig. 13 = unidentified leaf. I find, on recomparison, that this leaf is not the same as the type, and there is considerable doubt that the latter represents *Cercocarpus*.

Engelhardtia tuckeri Smith (*45*), p. 226, pl. 1, fig. 4 = *Acer* sp. This is a fragmentary three-lobed leaf. In 1941 I collected an almost exactly identical specimen at the same Hog Creek, Idaho, locality, but it is somewhat better preserved and has several teeth on the lobes.

Glyptostrobus? staminate aments. Berry (*4*), p. 239, pl. 63, fig. 1 = *Taxodium dubium* (Sternberg) Heer.

Hicoria washingtoniana Berry (*6*), p. 35, pl. 11, fig. 4 = *Magnolia dayana* Cockerell. The margins of this broken leaf and its counterpart are entire, not crenate as described and illustrated.

Limnanthemum circularis (Chaney) Brown (*16*), p. 352 = *Nymphoides circularis* (Chaney) Brown, n. comb. The currently accepted name for *Limnanthemum* is *Nymphoides* and the genus is considered as belonging to the Gentianaceae rather than the Menyanthaceae.

Liquidambar europaeum Al. Braun. Newberry (*43*), p. 100, pl. 47, fig. 3 = *Sparganium* sp. Although *Liquidambar* is present in the flora from the shales on Bridge Creek, Oreg., this fruiting head, originally attributed to *Liquidambar*, has single-beaked carpels, whereas those of *Liquidambar* are two-beaked. Fossil fruits of *Liquidambar* are coarser in appearance than those referred to *Sparganium* and usually display several deep cavities.

Liquidambar fruit. Knowlton (*34*), p. 42, pl. 10, fig. 10 = *Liquidambar pachyphyllum* Knowlton.

Magnolia spectabilis Knowlton. Berry (*8*), p. 93, fig. 1 = *Nyssa hesperia* Berry.

Nyssa knowltoni Berry. Brown (*13*), p. 184, pl. 62, figs. 1–3 = *Nyssa hesperia* Berry.

Nyssa knowltoni Berry (*4*), p. 261, pl. 59, fig. 7 = *Ptelea miocenica* Berry. Without seeing the specimens themselves I hesitate to pass judgment on the identity of the leaves identified as

Nyssa knowltoni by Arnold (*2*, p. 97, pl. 8, figs. 1, 5).

Populus, pistillate ament. Berry (*4*), p. 243, pl. 63, fig. 7 = *Taxodium dubium* (Sternberg) Heer.

Quercus deflexiloba Smith (*47*), p. 506, pl. 8, fig. 4 = *Quercus pseudolyrata* Lesquereux.

Quercus merriami Knowlton (*34*), p. 35, pl. 19, figs. 4, 5 = *Quercus payettensis* Knowlton.

Quercus spokanensis gracilis Berry (*7*), p. 110, pl. 20, figs. 4, 5 = *Quercus eoprinus* Smith. The specimens described by Berry, when compared with the specimen described by Knowlton as *Quercus spokanensis*, which is a *Castanea*, are found to be distinct, warranting the omission of the term *spokanensis*. As *gracilis* was once used by Newberry for a species of *Quercus*, which is now a synonym of *Dryophyllum subfalcatum* Lesquereux, the term *eoprinus* becomes valid.

Quercus ursina Knowlton. Berry (*8*), p. 92, fig. 8 = *Quercus pseudolyrata* Lesquereux. This specimen, as well as a number of others that are more typical of the species, comes from Grand Coulee, Wash. They are the first reported specimens of this species from the Latah formation.

Rhamnus idahoensis Brown (*13*), p. 181, pl. 56, fig. 4 = *Viburnum lantanafolium* Berry.

Rhododendron idahoensis Smith (*46*), p. 480, pl. 13, figs. 6, 10 = *Castanopsis perplexa* (Knowlton) Brown.

Salix florissanti Knowlton and Cockerell. Berry (*4*), p. 242, pl. 64, fig. 16 = *Salix hesperia* (Knowlton) Condit.

Salix spokanensis (Berry) Brown (*13*), p. 168, pl. 46, fig. 8 = *Sophora spokanensis* Knowlton. A reexamination of the petiole of this specimen shows transverse striations characteristic of most leguminous leaves and leaflets. Under occurrence and in the plate legend this specimen was erroneously listed as from Idaho City, Idaho. It is from Spokane, Wash. The specimens remaining in *Salix spokanensis* as given in my 1937 synonymy perhaps represent a mixture. Some seem to be small leaves of *Salix hesperia* (Knowlton) Condit. Others may not belong to *Salix*. However, I am not yet prepared to resolve this difficulty.

Sapindus idahoensis Smith (*47*), p. 518, pl. 13, fig. 6 = *Quercus simulata* Knowlton. The long petiole of this leaf removes the specimen from *Sapindus*.

Sequoia langsdorfi (Brongniart) Heer. Knowlton (*33*), p. 26, pl. 9, figs. 3–6; Berry (*7*), p. 104 = *Taxodium dubium* (Sternberg) Heer. All the material from the Latah formation in the National Museum collections, heretofore assigned to *Sequoia langsdorfi*, has stalked leaves without the prominent, twisted, decurrent bases characteristic of *Sequoia*.

Smilax lamarensis Knowlton. Berry (*4*), p. 240, pl. 63, fig. 15; Berry (*7*), p. 105, pl. 19, fig. 7 = *Smilax magna* Chaney. Although two species of *Smilax* could very well have been present in the Latah flora, the specimens so far reported could equally well have been produced by the same Miocene species.

Theobroma fossilium Berry (*5*), p. 8, pl. 1, figs. 13, 14. This specimen, considered by Berry to be the first fossil record of *Theobroma*, is a section of the forepart of a reptilian jaw. Berry mistook the bony structure for the pulp, and the teeth for the seeds of a chocolate-bean pod. Although described among Tertiary plants, the specimen, as stated by Berry, came from near Leiva, Department of Boyaca, Colombia, where Cretaceous strata crop out.

Umbellularia dayana (Knowlton) Berry. Brown (*13*), p. 174 [not pl. 52, fig. 13, which remains unidentified], all items except the original *Salix dayana* from the Mascall formation = *Cedrela pteraformis* (Berry) Brown.

Undetermined leaf. Brown (*13*), p. 186, pl. 53, fig. 13 = *Salix hesperia* (Knowlton) Condit.

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ETHNOLOGY.—*Ethnoherpetology of the Catawba and Cherokee Indians.*[1] Frank G. Speck, University of Pennsylvania. (Communicated by W. N. Fenton.)

Interest along lines of study in the shadowy historical background out of which the natural sciences emerge from the classical age of thought has scarcely yet gone far enough to make place for the present paper. Yet to venture ahead of time because it is important to record data on the animal lore of preliterate peoples leads to inquiry into newly opened fields of ethnozoology. Like the now-recognized subject of ethnobotany, the scope of ethnozoology will deepen and broaden as it assumes a place in the curriculum of research. Ethnoherpetology indeed offers unlimited prospects for exploration into native cultures far and wide, beginning with study in the environs of Indian tribes in the Americas.

No attention has been given so far to a treatment of native faunal lore among Indians of North America which might suggest that a rudimentary native system of zoological taxonomy existed. It might have been assumed that at least some beginnings of such a system would exist among tribes of mankind so familiar with animal appearances and habits.

The purpose of the present short paper, then, is to present hitherto unrecorded data on reptilian nomenclature of two unrelated tribal groups of the southeastern United States in order to illustrate the character of such an arrangement of reptiles based upon observation of descriptive details and habits.[2]

The two tribes from which the data here presented have been taken are the Catawba of the piedmont in northwestern South Carolina, near the border of the Upper and Lower Austral Zones, and the Cherokee of the mountains of western North Carolina, in the Transitional Zone. The reptilian biota of these regions differs considerably as the listing shows. The linguistic and cultural backgrounds of the two peoples are decidedly unrelated; the Catawba constitute a southeastern branch of the Siouan linguistic family; the Cherokee fall into the Iroquoian linguistic stock.

The Catawba material, I may say, is the accumulation of facts relating to reptiles and amphibians recorded during some years of continued but intermittent field work with the last four Indians who used the Catawba language. Chief Sam Blue was the principal source consulted in the revision of name identities of reptiles written down from dictation of older informants now deceased. A recent return-trip to the region gave an opportunity to review and revise the data previously obtained and to prepare

[1] Received April 26, 1946.

[2] Some of these ideas were touched upon in a short article presenting data on northeastern Algonkian reptile identities and reptile lore (F. G. Speck, *Reptile lore of the northern Indians*, Journal. Amer. Folklore **36** (141). July-Sept. 1923). See also F. G. Speck and E. S. Dodge, *Amphibian and reptile lore of the Six Nations Cayuga* (Journ. Amer. Folklore **58** (230). 1945).

In the preface to K. P. Schmidt and D. D. Davis's *Field book of snakes of the United States and Canada*, p. XI, 1941, the authors review the present situation in respect to reptile study: "In the past, study of American snakes has dealt chiefly with taxonomic problems. We believe that as purely taxonomic problems become less productive, interest will gradually shift to topics of broader biological interest. With this in mind, we have placed particular emphasis on life history, habits, behavior, and ecology. Description has been restricted to what is necessary for identification of specimens." Here also the subject of ethnoherpetology is unsensed as a possible line of investigation.

the list for final publication.[3] It is hardly possible now that more complete information along these lines can be expected, since the language and culture of the Catawba have become obsolete.

Departmental cooperation in projects of research in the Cherokee Nation resulted in the Cherokee material which is prepared from notes made in the field on the same occasions while collecting culture elements of the Eastern Cherokee. A number of informants were consulted, especially West Long of the Big Cove settlement. The notes have been extended by additions contributed by John G. Witthoft, University of Pennsylvania, who accompanied me on several trips of investigation.

An element of classification is evident in the material. Aside from the use of descriptive terms to denote the creatures some terms refer to ideas of pure folklore. But some remark may be made concerning the sources of reptile and amphibian names, both scientific and popular, in the European tradition of taxonomy. The naming system for reptiles (and the same may be said for other animal forms) among Catawba and Cherokee reminds the nature historian of the technical naming principles established by Linnaeus and others who long ago set the tradition of taxonomy by using Greek and Latin definitives in zoological classification.[4] The correspondence, indeed, between science and folklore in the naming of animals seldom evokes even passing thought among those who habitually use them, for most of us have blindly taught ourselves to take our own word traditions for granted in the quaint logic of science without seeking for their derivations.

In Indian systems of animal classification we find that groupings are usually determined by external features and habits of motion rather than by morphological distinctions. So the Catawba would insist that the whale is a fish as firmly as the biologist would deny it.

The tribal sources of observation from which nomenclature is drawn are only occasionally alike; the differences are due to differences in the cultures of Catawba and Cherokee, ethnic groups possessing unrelated languages and legendary heritages, and to their inhabiting different biotic zones.

CATAWBA REPTILE LIST

I. The Snakes

An essentially simple twofold classification of reptiles seems to have been achieved in the thought process of the Catawba which resulted in the naming of forms by groups embraced under classifying denominatives. Roughly compared with the taxonomy of biology one group of the class Reptilia may be correlated with the subclass Chelonia, designated in Catawba by the term kayá ("turtle" in free rendering), another with the subclass Crocodilia by the term hi·, "alligator." The category of reptiles corresponding to the order Ophidia we find de-

[3] Acknowledgements are made to the Faculty Research Fund, University of Pennsylvania (Grant 570), and the Field Research Fund in Anthropology for 1945, for support of the undertaking.

[4] Compare, for instance, the following scientific reptile designations, translated from Greek and Latin into English, with the Indian terms in the lists: *Crotalus horridus*, "rattler bristling"; *Sistrurus miliarius*, "rattletail containing a thousand"; *Agkistrodon piscivorus*, "fish-hook tooth fisheater"; *Heterodon contortrix*, "different-tooth twister"; *Coluber constrictor*, "serpent squeezer"; *Diadophis punctatus*, "crowned-snake spotted"; *Lampropeltis getulus*, "shining-shield African"; *Masticophis flagellum*, "whip-snake whip"; *Elaphe guttata*, "deer spotted"; *Liopeltis vernalis*, "smooth-shield springtime"; *Opheodrys aestivus*, "tree-snake summertime"; *Thamnophis*, "thicket-snake"; *Eutaenia*, "beautiful band"; *Natrix sipedon*, "swimmer tube-tooth"; *Cemophora coccinea*, "muzzle-bearing scarlet."

I must acknowledge the aid given me in tracing sources and meanings of these terms by Dr. W. W. Hyde and Miss Anna K. Stimson, of the University of Pennsylvania. I have also made use of E. C. Jaeger, *A dictionary of Greek and Latin combining forms used in zoölogical names*, Baltimore, 1931, and D. S. Jordan, *Manual of the vertebrate animals*, Yonkers-on-Hudson, 1929, for the same purpose.

To Dr. R. M. Stabler, Department of Zoölogy, University of Pennsylvania, I am indebted for critical reading of the material as presented and for his comments on its arrangement. By his advice as a taxonomist I have not included names of subspecies or authors of descriptions in the listings of identities. The nomenclature follows L. Stejneger and T. Barbour, *A check list of North American amphibians and reptiles*, Cambridge, 1933.

noted by the term ya, "snake" in general. (Without digressing from the topic of reptiles at this point, it may be noted incidentally that group designations include other classes of the faunal realm, tcų, "insect"; yi·, "fish"; kutcín, "bird"; and so on—all generalizing collective terms.)

The Catawba binomial system of phylogeny then drops to a designation for species by the use of specific modifiers of the generic term ya, as the following list will show. One might add that a possible recognition of subspecific characters is vouched for by use of the modifiers tų, "little," and tərό, "big," as suffixes to some specific names.

The list of 17 specific snake names known to informants is as follows[5]:

1. ya swą'ʔ, "snake chief," king, or greatest, rattlesnake (*Crotalus horridus*). The snake of paramount importance in the nature lore of the Catawba, and the Creeks as well, who denote it similarly (tcít·o mi'k·o, "snake chief").

2. ya mantúgrere, "snake home in ground," ground rattlesnake (*Sistrurus miliarius*).

3. ya pɑ'kɑta tcesá, "snake narrow-necked," copperhead (*Agkistrodon mokasen*).

4. ya yámure, "snake staying in water," water moccasin (*Agkistrodon piscivorus*).

5. ya hi· skɑ' kwątcere, "snake head spreads," hog-nose snake (*Heterodon contortrix*). ya wį· túp', "snake spotted."

6. ya wáktciye, "snake black," black racer (*Coluber constrictor*).

7. ya tų wáktciye, "snake little black," ringnecked snake (*Diadophis punctatus*). The Catawba regard this reptile as an immature form of the black racer.

8. ya migráhərе, "snake chief," king snake (*Lampropeltis getulus*). The specific term is a synonym of the term given for rattlesnake. To the informant this is a "boss of snakes." The term ya suré, "snake wild," was also given for this animal by Sally (Brown) Gordon in 1928.

9. ya tiríre hɑ, "snake thunder present," milk snake (*Lampropeltis triangulum*). The identification of this species was uncertain to the informant.

10. ya yispá hę, "snake whip," coachwhip (*Masticophis flagellum*). The informant, Sam Blue, had heard that this creature could "stand up and whistle!"

11. ya nəmotúksa hę, "snake in ground stays," corn snake (*Elaphe guttata*).

12. ya tų nəmómusàre, "snake small in ground stays" (*Cemophora coccinea*).

13. ya wədésəna, "snake cow male" (or "bull snake" locally), gray rat snake (*Elaphe obsoleta confinis*). This form was not well known to the informant.

14. ya waŋká', "snake green," rough green snake (*Opheodrys aestivus*). ya ya'ɑ', "snake (pertaining to) woman." The second name was obtained from Margaret Brown in 1920.

15. ya yəmaterá, "snake garter," garter snake (*Thamnophis sirtalis*). The name applied to this form is manifestly of local English origin.

16. ya yąyamǫmúre, "snake in water lies" (*Natrix sipedon*).

17. ya yątce''mowàne, "snake in branch (creek) stays," queen snake or leather snake (*Natrix septemvittata*).

OTHER CREATURES CLASSIFIED AS SNAKES BY THE CATAWBA

1. ya kɑt'k'ɑt'hərе, "snake jointed," glass snake (*Ophisaurus ventralis*). The modifier here is equivalent to "breaks into pieces." The "glass snake" is included in the list because of its snakelike character in Catawba esteem. It was not familiarly known to the informant who had encountered it only rarely. Said he, "Unless the pieces of its body are thrown into the river or burned, it will come alive again."

2. ya ciyé, "snake (in) mud," eel.

An attempt to identify other species known to literature of the region did not yield results with Indians questioned even with the help of the color plates and descriptions of appearance and habits.

[5] Herpetological identification was checked by use of excellent color plates in *The snakes of Maryland*, H. A. Kelley, A. W. Davis, H. C. Robertson, The Natural History Society of Maryland, Baltimore, 1936.

The symbols used in writing native terms in both languages of the notations are those customarily adopted by students of American linguistics. It may be noted for the convenience of those who are not concerned with details of phonetic transcription that the following letters differ from their use in English orthography, their equivalents being: *c* for English *sh*, *ɑ* (Greek alpha) for the *u* sound of English *but*, *ə* (inverted *e*) for the almost silent *e* in English *her*, a cedilla beneath a vowel to denote nasalization, the symbol ʔ for the glottal stop, ' to indicate an aspiration after a vowel or consonant, and the raised period to show lengthening of vowel. *ɔ* (reversed *c*) is used in Cherokee to denote *aw* as in English *law*.

REPTILES IN CATAWBA FOLKLORE[6]

Snake lore among the Catawba includes reference to the fabled hoop snake (ya tərą́ tərą́? həre, "snake rolling"). Chief Sam Blue when questioned about the creature claimed to have seen it himself, and he said it had a brownish color. The legend of its existence is evidently one derived from white neighbors with whom the Indians have been associated for over a century.

The folklore of reptiles is unduly meager in the surviving body of tradition among the Catawba. Fables relate how a monster serpent dwelt in a turgid eddy of the Catawba River near one of the ancient villages. The serpent killed people by sucking blood from their necks or from under their arms. Another child-killing snake monster of the river constricted its victim. The symbolism of the snake in tribal tradition is that of enmity, and the people usually kill snakes for this reason when they are encountered. The poisonous species are categorically denoted by the term ya sigrí·, "snake mean, polluted, unfit, spoiled, dirty," according to the divergently "unfavorable" meaning indicated by the adjective modifier.

Several snake taboos are to be noted as told by Mrs. Susan Owl and Margaret Brown a number of years ago.

To narrate stories after dark is to invite annoyance from snakes. If a snake hears a person relating tales it will lie in wait in the path for him or her.

Likewise, if a person mentions aloud his business or intentions regarding travel, a snake may hear it and lie in wait for him. Consequently the wary are advised when about to travel anywhere to speak of going "day after tomorrow" instead of "tomorrow," in order to deceive the snake. Indeed "if he knows where the traveler is going he will try to lie in wait for him!"

[6] Few writers in this field have touched upon the folklore of snakes, and then only to deal briefly with popular beliefs of the American countryside among which the "hoop snake," "milk snake," "glass snake," "swallowing of young" stand out. (See K. P. Schmidt and D. D. Davis, *Field book of snakes of the United States and Canada*, 1941, for a section on Folklore of Snakes (pp. 7–10) and references to K. P. Schmidt and R. V. Medden for more extensive reference to essays on snake lore.) In an article, *The hoop snake story*, K. P. Schmidt quotes references to the hoop-snake legend in the South and suggests a Negro origin for it as a possibility (Nat. Hist. **25** (1): 76–90. 1925).

The story is told of an old man years ago who had a watermelon patch visited by girls who would steal them. To keep them out he put white-oak splints around the field and caused them to be transformed into snakes when intruders came.

In Catawba tradition, as far as a conclusion can be reached, all snakes are maleficent, and that means potentially poisonous in their relationship to man. Whether the baneful influences are exerted through spiritual or physiological mediums (fangs or teeth) is not considered to be precisely essential to personal protection and welfare. Only in the case of death and disablement resulting from the bite of rattlesnake, moccasin, or copperhead is observation of cause and effect specified. The hog-nose snake is equally feared, and, in the estimation of some of the people, others as well. Hence snakes may inflict injury and death, through tongues or teeth in direct contact, and inflict sickness, misfortune, or ill fate through mysterious toxic agencies of a spiritual nature. These conceptions are vaguely garbled and vary individually as might be expected among folk whose minds are trained to reason by tradition drawn from two realms, the real and the unreal.

II. The Turtles

The four reptiles of this category recognized by the Catawba are all denoted by the classifying term ka or kayá, "turtle." The latter term may have semantic relationship with that for snake (ya).

1. ką́i, "turtle" (or possibly "scratcher"), box turtle (*Terrapene carolina*).

2. kayá, "turtle snake" (locally, cooter terrapin), members of the genera *Malaclemys*, *Chrysemys*, and *Pseudemys*, without distinction.

3. kayá skąteró, "terrapin head big," snapping turtle (*Chelydra serpentina*).

4. kayá səmí·? "terrapin soft," soft-shelled turtle (*Amyda ferox*). The flesh of this creature is prepared and eaten by the Catawba.

The attempt to identify with precision the native names of the musk and mud turtle proved unsuccessful. The following names were taken down as applicable to one or the other:

1. ka səmí·?, "turtle soft," musk turtle, or stinkpot (*Sternotherus odoratus*).

2. kaya tcí·re?, "terrapin mud (?)," mud turtle (*Kinosternon subrubrum*), also a variant

term kąʔi·e applied loosely to both creatures at different times by Mrs. Owl (1920) and Margaret and Sally Brown and Sam Blue in later years.

III. The Lizards

The Catawba denote the saurians by the collective term wapirę́ʔ, "lizard"; one hardly capable of analysis at present unless the primary element wap may have reference to something round in form. Three true lizard forms are recognized as follows. Salamanders are included with them in the Catawba arrangement.

1. wapirę́ʔ hiskąʔ səkąʔre, "lizard head red" (locally scorpion), blue-tailed skink (*Eumeces fasciatus*). The name is derived from the reddish head of the fully adult male. The young phase of the reptile with striped back and blue tail was known to the informant correctly as an age phase of the same creature. This knowledge seemed noteworthy for Indians since it is not usually so understood among surrounding whites.

2. wapirę́ʔ wąʔka ʔ, "lizard green," American chameleon (*Anolis carolinensis*). The Catawba believe the chromatic stages of the animal to be due to its need to simulate the color of its immediate background.

3. wapirę́ʔ, "lizard," swift or fence lizard (*Sceloporus undulatus*). The tailed amphibians are also included in the nomenclature of lizards, owing to their lizardlike form of body.

4. wapirę́ʔ yątci're, "lizard (in) branch (of river or spring)" (*Desmognathus fuscus auriculatus*). Found abundantly on the reservation in the "branches" of Catawba River in the usual haunts under stones, and the informants gave the same native name to all the other varieties known within their range.[7]

IV. The Frogs and Toads

In the native system of zoonomy there seems to be no grouping of the suborders of the Anura, there being but one inclusive term for the family Bufonidae and another for the Hylidae and Ranidae. The distinction usually observed is that of size, which is indicated by suffixes denoting "large" and "small."

1. arąʔrai, frog, specifically bullfrog (*Rana catesbeiana*), an inclusive term for all forms of the genus *Rana*. It is onomatopoeic, a native reproduction of the sound impression of the voice of *Rana*, although it referred specifically to the green frog (*Rana clamitans*) as heard in 1946 in the swamps of the reservation. Chief Sam Blue mentioned a belief among the Catawba that when the frog's voice is heard "fish bite well" (arąʔrąi kauhatcu're yi·sóhewe).

2. ka're, frogs known as "knee-deep"[8] (*Hyla, Acris*, and *Pseudacris*, undifferentiated).

3. watcikamú, "(?) suck," toad (*Bufo*, species undifferentiated). Why the same name should apply to the leech remains unexplainable.

An instance of folk belief in linkage by metamorphosis between *Bufo* and *Rana* was given by Margaret Brown, an aged Catawba woman who died in 1922. She related how the people believed that the toad laid eggs "which turn into tadpoles and after a certain length of time these turn into bullfrogs."

CHEROKEE SNAKE NAMES AND IDENTITIES

The following list of 14 species with their Cherokee native names and explanations represents the knowledge possessed by Will West Long, a linguistic purist and traditionalist of the Big Cove settlement, Qualla Reservation of the eastern Cherkokee, Swain County, N. C. Big Cove is an elevated basin (above 3,000 feet) at the foot of the main ridge of the Great Smoky Mountains. In the lower levels of the reservation, however, the Indians are acquainted with more reptilian forms, and such names and identities are added from notes made there recently by John G. Witthoft.

West Long, who knew only the forms in his own district, by his own testimony was unacquainted with the water moccasin, the whip snake, the scarlet snake, the "glass snake," and even the milk snake. Therefore for them he had no native names that could be definitely assigned to species. We found no authoritative sources to check occurrences of these creatures in the district of the Big Cove to which the list applies. A complete local collection of forms found there would be necessary to settle this point of distribution in the immediate neighborhood. West Long, furthermore, disclaimed

[7] Questioning informants about the occurrence of the mudpuppy in Catawba River revealed that it was not known to the Indians of the reservation.

[8] An explanatory folk narrative told by Chief Sam Blue relative to the locally popular name "knee-deep": "Said the bullfrog on the edge of the swamp, 'Come on in!' Another frog cried out, 'How deep?' The tiny peepers called out, 'knee deep'!"

knowledge of the legendary hoop snake. Witthoft, however, obtained a reference to it from other sources.

The lack of correspondence between the Catawba and Cherokee snake lists is accounted for, in part, by the differences in topography of their respective habitats. Certain forms are not known to the mountain regions. Moreover, the two peoples belong to unrelated families of speech (Catawba is of the Siouan linguistic stock, Cherokee is Iroquoian), whence the total nonrelationship of their reptilian terminologies.

In presenting the material from the Cherokee here no attempt is made to include reference to reptile lore of the tribe. The extent and wealth of such matter would require a comprehensive monograph, which would cover much of the religious and ceremonial life of the people. Reptiles, indeed, play a highly important role in Cherokee tradition.

Where the technical designations for snakes correspond with those in the Catawba list they are not repeated.

The Cherokee generic term for snake is i·natą́.

1. udzǫ́ natą́ʻ, "now you see snake," rattlesnake.

2. kạdzétʻi·, "rattle," ground rattlesnake. The term is identical with that for the gourd rattle carried in the hand of a dance leader.

3. w'ɔ təgi· askɔ'liʻ, "brown head," copperhead. Also tsiúk tadzistaí, "with fire eye."

4. kiʻzi·dzulíʻ, "feces has in it," hog-nosed snake. The term is not explainable in origin beyond the possible idea that the forcible hissing of the creature was caused by an excess of substance in its abdomen producing the described condition.

5. kaʔlekʻgíʻ, "he climbs up a tree," black snake.

6. kaʔlekʻgíʻ atʻą́ʻ, "blacksnake young," ringnecked snake. This is regarded as a young phase of the black snake.

7. wuckəlihą́ i·natʻʔạnihę́, "boss snake king," king snake (informant, Amanita Tramper). Neither the animal nor its name was known to West Long.

8. i·natʻ ugą'wi·yahị, "snake king," milk snake (questionable).

9. gi·gé i·natą́ʻ, "red snake," corn snake. West Long had encountered the species only once and was not certain of its identity.

10. ukʻsuhį́·, "substance in the eye," mountain blacksnake. West Long could offer no explanation for the origin of this name.

11. selikwɔ́yíʻ, "green," smooth green snake (doubtful) and rough green snake.

12. odalíʻakʻtiyàʻ (odalíkʻ tiyà, shortened form), "mountain guard," yellow-striped chicken snake. The name describes the habit of the creature to lie atop the mountain, among rocks it is said, to watch the movements of other animals. The common idea is that it acts as a guardian observer of life on the mountain. The same term is applied to the garter snake through its similarity in stripes to the preceding. Observation has apparently been lax among the Cherokee in regard to differences in appearance and habit of these reptiles. Some doubt rests in the identity of the 4-lined chicken snake referred to.

13. kənégwɔdíʻ, "goes underground and pushes soil up," water snake and queen or leather snake. The term is general for all phases of the genus *Natrix*. Color variations are denoted by descriptive terms.

14. i·nátʻ ạtʻį́· kalaǫskį́·ʻ, "snake pottery breaking," worm snake (*Carphophis amoena amoena*). Explanation of this name is beyond the ability of anyone questioned regarding its application. It was stated that if the worm snake is placed on the head of any one infested with lice the vermin will disappear.

Jimsie and Tahquette Wallace, of Adam's Creek, near Birdtown, on the reservation about 16 miles from the Big Cove and at a lower altitude, recognized the following varieties (notes contributed by J. G. Witthoft):

15. djogés ɑktiyà, garter snake and redbellied brown snake.

16. toledą́, glass snake.

17. onegast ànìistíʻ, "hoop snake." There are said to be two varieties, neither of which the informants have seen. They are somewhat skeptical about the existence of this snake but say it may have existed in the lowland environment that some of the Cherokee formerly inhabited.

18. waskatíʻ, milk snake.

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PHYSICS.—*Fahrenheit and Roemer.*[1] N. ERNEST DORSEY, National Bureau of Standards.

In 1910, Kirstine Meyer (*1*) announced the finding in Copenhagen of a notebook of Ole (or Olaf) Christensen Roemer, the noted Danish astronomer. Its title is *Adversaria*, and it contains entries concerning thermometers, of which Roemer made several for his own use. She was especially impressed by the fact that he used the number $7\frac{1}{2}$ to denote the ice-point, and that the same number, or an integral multiple of it, was similarly used by Fahrenheit for certain of his earlier thermometers. She was right in inferring that such an occurrence of this fractional number indicated an attempt to correlate the scales used by the two men. But, being unduly anxious to add to Roemer's already most enviable reputation, she bent every effort to convince the reader that it was from Roemer that Fahrenheit obtained everything that was needed for designing his celebrated thermometers, and even that Roemer was the first to realize the advantage of basing a thermometer scale on two fiducial temperatures, each determined by a natural phenomenon. She misread the evidence and reached false conclusions.

Those conclusions were repeated and amplified in 1913 (*2*) and again in 1937 (*3*). To the last, J. N. Friend (*4*) replied, criticizing it rather mildly. They have reappeared, summarized in a single paragraph, in a booklet issued late in 1944 by I. Bernard Cohen (*5*), who seems to have approved of them.

The persistence of these errors for more than three decades seems to call for a study of the evidence on which they rest and an exposition of their erroneous nature. Such is the prime purpose of this article. Incidentally, there are offered certain suggestions, more plausible than those of Meyer, regarding Fahrenheit's indebtedness to Roemer, and new suggestions regarding the nature and the origin of the change Fahrenheit made in his scale in 1717. And finally the Cohen summary of 1944 (*5*) of Meyer's conclusions is quoted *in extenso*, for comparison with the corresponding, but in part quite different, conclusions reached in this study.

It seems well, however, to consider at once the last sentence of Cohen's summary, expressing Meyer's ultimate conclusion as to the indebtedness of Fahrenheit to Roemer. That sentence is this: "Thus it is quite clear that it was Roemer who invented the modern thermometer and that the Fahrenheit thermometer should, in all fairness, be called the Roemer thermometer!"

Whatever the debt that Fahrenheit may have owed to Roemer, the last assertion in that sentence can not be accepted, for the very simple reason that Roemer did not publish any of his ideas about thermometers or any account of his work either with or upon them, nor did he, so far as we now know, do anything to make his thermometers generally available to scientific men. He made the thermometers for his own personal use. All that we know about them has come to light within the past 36 years, after two centuries of oblivion. On the other hand, Fahrenheit produced a superior thermometer, improved its construction from time to time, readjusted his scale in 1717 so that it would accord more accurate-

[1] Received September 11, 1946.

ly with its nominal fiducial points, distributed his thermometers widely, and published brief descriptions of their graduation and use. His thermometers became highly valued throughout the scientific world. To him belongs the credit.

It is not a question of who first had the idea or first made the instrument, but of who first made the idea or instrument available to the scientific world. No one can know how many may have had the same idea or made the same type of instrument, but kept it all to themselves, perhaps recording the idea or method of construction in personal memoranda that may some day be brought to the notice of the world. The bringing of such memoranda to notice is of great value for the light they throw on the activities of the man but is valueless for establishing his claim for priority over one who actually gave the idea or instrument to the world.

Meyer's earlier statements regarding Fahrenheit and Roemer rested almost exclusively on Roemer's *Adversaria*, which was published in 1910 by the Royal Danish Academy, as a beautiful volume of 271 pages (*6*, *17*), under the editorship of Thyra Eibe and Kirstine Meyer, and were made prior to the publication (*7*) in 1936 of Fahrenheit's letter of April 17, 1729, to Boerhaave. That letter was, however, considered in her reply to Friend (*3*).

Hence it is necessary to consider carefully both what is said in *Adversaria* regarding Roemer's thermometers and what the letter tells of the relation between the two men. But first one should recall something of the status of the science of heat at that time, and of the various practices that had already been proposed, and perhaps adopted, for defining thermometer scales. For Roemer (*5*) and Fahrenheit (*7*) were great travelers, and an important and avowed purpose of their travels was to meet men of science and to learn what was being done and thought in the world of science. At that time the construction and use of thermometers furnished a very live subject indeed, and it is inconceivable that either man should have failed to discuss it with those he met. It seems entirely fair to assume that each knew, or by his travels became acquainted with, the general state of affairs and that each made use of the information he obtained. That would be entirely proper. And no one should give to either the credit for having initiated or for having taught the other anything that was already generally known.

At the time with which we are concerned, it was very generally believed that heat was a substance that could be added to or removed from a body and that the thermometer reading gave an indication of how much heat the body contained (*8*, p. 858). Consequently, it seemed most elegant for the zero of the scale to correspond to the condition of zero heat, to the lowest possible temperature. The lowest temperature that had been observed was that produced by a mixture of snow, water, and sal ammoniac (NH_4Cl), or perhaps, sea salt: roughly 0°F. And it seems that, up to the severe winter of 1708–09, no air temperature nearly so low as that had been recorded by any thermometer. That temperature therefore became a preferred zero for thermometer scales, and some seem to have thought that it was the absolute zero—the temperature at which there is no heat in the body.[2] However that may be, quite a little excitement was caused when the temperature at Copenhagen in 1708–09 fell almost to that zero.

True, Amontons (*9*) had a different conception of heat, and he properly inferred from his air-thermometer that the absolute zero was far lower than that obtained by

[2] Muncke [*8*, p. 859+] has written: "Der strenge Winter von 1709, wobei er [Fahrenheit] sicher die Temperatur mit seinen noch unvollkommenen Thermometern mass, führte ihn auf den wichtigen Schluss, das der Punct das schmelzenden Eises nicht der eigentliche Nullpunct der Wärme sey, aber leider, glaubte er, in der damals erlebten grössten Kälte diesen Punct gefunden zu haben, und nahm ihn daher als den Anfangspunct seiner Thermometerscale." Muncke is surely wrong in thinking that the winter of 1708–09 convinced Fahrenheit that the zero of heat lay below the ice-point; for it was already known that a mixture of water-ice-NH_4Cl had a temperature much lower than the ice-point. That very low temperature seems to have been the temperature which he and many others regarded as indicating zero heat. To them the surprising thing was that in the winter of 1708–09 the air temperature came within a small fraction of a degree of that low temperature.

means of the water-ice-salt mixture. But he was ahead of his time.

Another temperature to which great importance was attached from the time of the earliest thermometers was blood-heat or body temperature. That term was believed to define a definite temperature, but it was variously understood. For example, it was taken as the temperature in the bodies of cows (*10*) and deer (*10*), the temperature of the human body (*11*), of a pullet sitting on eggs (*11*). It remained for Fahrenheit (*12*) to specify explicitly that blood-heat is to be understood as the temperature registered by a thermometer when in the mouth or armpit of a healthy man. As we know today, and as Fahrenheit may have known, even that temperature is far from constant. Did he refer to the lowest, the highest, or some intermediate temperature?

Both the ice-point and the boiling point of water were by many experimenters believed to be variable. That is not surprising. At the time, nothing was known about phase equilibrium. The ice-point was variously defined as the simple cold of snow (1657–67) (*13*), cold snow (1669, Fabri) (*14*), as the temperature at which water begins to freeze (1665, Huygens; 1701, Newton) (*15*, *11*), as that of melting snow (1701, Newton) (*11*). The boiling point was defined as the temperature of water when it is boiling, the thermometer being immersed in the water. That temperature depends not only on the atmospheric pressure, an effect that was beginning to be recognized, but also on how vigorously the water boils. Newton (*11*) reported that water begins to boil at 33° on his scale and boils vehemently at 34 to 34½ —a difference of 1½ of his degrees, corresponding approximately to a difference of 8°F.

Various other natural phenomena were proposed from time to time as means for specifying fixed temperatures. But until Fahrenheit's improved thermometers became generally available, temperature measurements by different observers could not be satisfactorily compared, and consequently it was exceedingly difficult to reach a general agreement as to whether, and if so, under what conditions, the several proposed phenomena do actually specify fixed temperatures.

Two distinct, but entirely valid, principles had been proposed and used for defining a thermometer scale. One (Boyle, 1665 (*14*); Hooke, 1664 (*14*); etc.) involves the choosing of a single fiducial temperature defined by a natural phenomenon, and the choosing of a definite thermometric liquid. A numerical value is assigned to the fiducial temperature, and starting from that point a scale is so laid out that each step corresponds to a certain fixed specified fraction of the volume of the thermometric liquid when at the fiducial temperature.

The other, and older, principle (Sanctorius, 1612 (*14*); Sagredo, 1615 (*15*); the Florentine thermometers, 1657–67 (*13*); Fabri, 1669 (*14*); Newton, 1701 (*11*); etc.) involves the assigning of a value to each of two conveniently separated temperatures defined by natural phenomena, the dividing of the space between those two readings into steps of equal change in volume, and the extending of the scale beyond those fiducial temperatures, as may be desired. (In practice it was usually assumed that the tube was cylindrical, but as early as 1665 Boyle had called attention to errors arising from irregularities of the tube, and to the desirability of dividing the tube into lengths of equal volume.)

In Table 1 are given the natural phenomena defining the two fixed points of each of a number of scales that had been proposed—and mostly used—prior to 1702. (The meeting of Fahrenheit and Roemer was in 1708.) In some cases the numbering of the divisions was such as to suggest that the lower end of the scale was supposed to indicate, at least approximately, the temperature of an ice-salt mixture.

Although the definitions of these fiducial temperatures leave much to be desired, it is obvious that the principle of defining a thermometer scale in terms of two fiducial temperatures was known for upward of a century before Fahrenheit's visit to Roemer.

Turn now to Roemer's *Adversaria* (*17*), from which all we know about Roemer's thermometers seems to have been derived, and on which Meyer bases her extravagant

claims. As the title indicates, it is a notebook in which Roemer jotted down ideas, proposed procedures, preliminary computations, certain results obtained by himself or by others, curios in which he was interested, etc. For example: On 16 consecutive pages there are entries on the following subjects: Astronomical calculations (pp. 79–80); speed of travel of porters, travelers, runners, horse with load, etc. (80–83); monthly rainfall in Paris, 1689–1704 (83); astronomical notes (84–85); rate at which a horse (man) can raise water to each of certain heights (85–87); magic squares (87–94, continued from 36–42); atmospheric refraction (94). This strictly casual nature of the contents of *Adversaria* should be kept in mind in any attempt to interpret them.

Roemer's notes are in Latin, occasionally in Danish, and at various places P. Horrebow, a contemporary, has written in memoranda, sometimes, but not always, signed. It seems certain that those memoranda were inserted after Roemer's death. Some of them refer to Roemer's widow.

References to thermometers occur as follows: On pages 11–12 Roemer states that air expands by one-ninth of its volume when its temperature is increased from 8 to 18 degrees of his thermometer ("in calore meorum thermometrorum"), and that water expands by 1/200 of its volume under the same conditions. Since his 8 lay near 0°C., the ratio of these two expansions is about right; and the expansion of air indicates that each of his degrees corresponds to about 3°C.

On page 119 are recorded the observed linear expansions of 6 metal rods (Au, Cu, Ag, Sn, Pb, and Fe) for the range $6\frac{1}{2}$ to $30\frac{1}{2}$ on his thermometer. By comparing those values with the coefficients of expansion as given in the Smithsonian Physical Tables, one finds, for one of his degrees, values ranging from 1.80°C. (Fe) to 2.18°C. (Au), the average being 1.95°C., which is only 65 percent of the value derived from the data on pages 11–12.

After some pages devoted to the setting up and testing of several approximate formulas for the rapid subdivision of a conical tube into sections of equal volume, there comes on page 210 a memorandum entitled "Originale thermometrum construere" (to construct an initial thermometer; i.e., one not dependent upon another), in which are instructions for the making of such an independent thermometer that will read $7\frac{1}{2}$ in snow-and-water, and 60 in boiling water. The dependence of the latter temperature upon the vigorousness of the boiling, and its resulting indefiniteness, are not mentioned. Neither is the effect of variations in the atmospheric pressure. If one assumes that this 60 corresponds exactly to 100°C., then each degree will correspond to 1.90°C.

This is the sole reference in *Adversaria* to Roemer's 60-degree thermometer, and it should be noticed that he does not say that he ever constructed such an instrument. The verb "construere" occurring in the title is in the infinitive; the section merely tells how such an instrument might be con-

TABLE 1.—EARLY THERMOMETER SCALES BASED ON TWO FIDUCIAL POINTS

Year	Name	Lower temperature	Upper temperature	Ref.
1612	Sanctorius	Snow	Approach of candle	(*14*)
1615	Sagredo	Snow and salt	Snow	(*14*)
Prior to 1667	Florentine	Snow or ice	Midsummer sun[1]	(*13*)
1669	Fabri	Snow in cold weather	Direct summer sun	(*14*)
1670	de la Hire	Air when freezing	Deep vault	(*14*)
	de la Hire	Snow and salt	Solidifying tallow	(*16*)
1688	Dalencé	Freezing water	Melting butter	(*14*)
	Dalencé	Freezing water	Deep vault	(*14*)
1694	Renaldini	Melting ice	Boiling water	(*14*)
1701	Newton	Melting snow	Temp. of human body	(*11*)

[1] Lambert [16], on the authority of Borelli and Malpighi, has stated that the temperature in the sun on the hottest day in summer, in Florence, is the same as that in the body of a cow, a deer, etc. That is, within the then current limits of precision, the upper temperature is essentially blood-heat, and it may have been chosen for that reason.

structed. And it makes no mention of difficulties that one might expect to encounter in trying to use 100°C. as a fiducial point for an alcohol thermometer. However, it is probable that he did make at least one such thermometer.

From this section, Meyer concluded that the fiducial points defining Roemer's scale were the ice-point (marked $7\frac{1}{2}$) and the boiling-point (marked 60). But, as Friend (*4*) has pointed out, it is most improbable that Roemer's lower fiducial point was the ice-point. It is almost incredible that an experienced investigator would assign a fractional number to a fiducial point. But having otherwise established his scale, it would not be at all unreasonable for him to use, for its reproduction, other temperatures defined by natural phenomena that are more convenient to use than those defining the fiducial points. Those other temperatures will in general not be represented by integral degrees on his predetermined scale. Their proper nonintegral designations must be determined experimentally, directly or otherwise. Whence one should regard the $7\frac{1}{2}$ as the experimentally determined value of the ice-point on his scale; and should infer that his lower fiducial point lay $7\frac{1}{2}$ of his degrees below the ice-point. That would place his zero near the temperature of a water-ice-NH_4Cl mixture, which, as has been seen, was widely held to be the most elegant starting point. That was probably the temperature which he desired his zero to represent. But whether the $7\frac{1}{2}$ was directly determined by experiment, or was arrived at in another way as a mere, but satisfactory, approximation to the distance of the water-ice-NH_4Cl temperature below the ice-point, is another matter, which will be considered more fully in connection with the Fahrenheit letter.

Then, after some remarks by Horrebow, come other pages (211–213) devoted to the subdivision of conical tubes.

Page 214 is a facsimile of Roemer's plot of the daily temperatures, presumably at Copenhagen, during the severe winter of 1708–09. There is no statement about either who took the temperatures or what thermometer was used. The days are arranged in a vertical column, and the temperatures are recorded to the right in a grid completed by 9 vertical lines, each corresponding to a degree. These lines are numbered at their tops 8, 7, 6, · · · 2, 1, 0. Above those numbers, and in another hand, possibly Horrebow's, are written the same numbers in reverse order. Above them and inverted is written, Meyer says by Horrebow, the remark "mutaverat ergo Roemerus primum suum propositum," which Meyer (*1*) interprets, probably correctly, as meaning that Horrebow concluded from the numbering of those vertical lines that Roemer had changed the designation of the ice-point from $7\frac{1}{2}$ to 8. Indeed, in an earlier note (p. 211) Horrebow states, apparently on the authority of this sheet, that Roemer denoted the ice-point by 8. The only ground for such a conclusion is Roemer's failure to rule a line at $7\frac{1}{2}$. But why should one expect him to rule such a line? It would have merely introduced confusion in the grid. He knew where the ice-point lay—just halfway between lines 7 and 8. That remark by Horrebow seems to me to be totally unjustified; indeed, I have found nothing to indicate that Roemer ever denoted the ice-point by 8. That statement of Horrebow's was, however, fully accepted by Meyer. In fact, it was seized upon as evidence that Fahrenheit's 32 for the ice-point was taken from Roemer, being merely 4 times his 8. As will be seen presently, Fahrenheit's 8, or 32, had nothing whatever to do with the numbering of the degrees on Roemer's thermometer.

There seems to be in *Adversaria* nothing more bearing upon Roemer's thermometric work.

Whether the discrepancy between the several sizes of Roemer's degree as derived from his data for expansivities and from his instructions for constructing the 60-degree thermometer—3°C. (pp. 11–12), 1.95°C. (p. 119), 1.90°C. (60-degree thermometer)—arises from experimental errors or from discrepancies between the thermometers, is not known. No detail of the experimental work is recorded, and nothing is said about the thermometers except that they were his own. These data, however, and they are all

we have, scarcely justify Meyer's conclusion that Roemer's thermometers were superior instruments. Any such conclusion can rest only on his general reputation.

However, *Adversaria* shows beyond doubt that Roemer was well acquainted with the procedures that must be followed and the care that must be taken in the construction of thermometers if they are to be accurately reproducible. He fully realized the importance of subdividing the stem into lengths corresponding to equal volumes; he advised the rejection of tubes that are neither cylindrical nor conical, and he gave convenient methods for dividing the latter into lengths that would be sufficiently nearly of equal volumes. These approximate methods were proposed for the purpose of reducing the computational labor that is involved in an exact division.

Turn now to Fahrenheit's letter of April 17, 1729, to Boerhaave, which contains all that is known about Fahrenheit's intercourse with Roemer. That letter seems to have been written in reply to a question as to how he was led to his great improvement of the thermometer. From a German[3] translation (7) of that letter, the portions of present interest may be Englished as follows:

As for the means by which I have succeeded in the way of improving thermometers, I am most pleased to tell you that I received the first suggestion thereto in the year 1708, during a conference with the renowned Roemer in Copenhagen; for as I visited him one fine morning, I found that he had placed in a mixture of water and ice some thermometers which he later dipped again into warm water which was at blood-heat, and after he had marked these two limits on all the thermometers, he added downward from the point corresponding to the vessel of ice [and water] one half of the distance so determined, and divided the entire distance into $22\frac{1}{2}$ parts, beginning with 0 at the bottom, then $7\frac{1}{2}$ degrees for the point in the vessel of ice [and water], and $22\frac{1}{2}$ for that at blood-heat, which division I also used until the year 1717, except that I divided each degree into four smaller parts. In this manner were divided the scales of the two thermometers that Professor Wolf reported upon in Acta Lipsinia in August, 1714. Since this division is inconvenient and inelegant on account of the fractional numbers, I decided to change the scale, and instead of $22\frac{1}{2}$ or 90, to use 96, which I have done ever since, and which, although it was not so intended, I found to agree approxi-

[3] "Was nunmehr die Mittel betrifft durch welche ich auf den Weg der Verbesserung der Thermometer gelangt bin, so sei Ihnen freundlichst mitgeteilt, dass ich Ao. 1708 durch den Verkehr mit dem trefflichen Roemer in Kopenhagen dazu die erste Anregung erhalten habe, denn als ich eines schönen Morgens einmal zu ihm kam, fand ich, dass er einige Thermometer in Wasser und Eis stehen hatte, welcher er später wieder in warmes Wasser taucht, welches blutwarm war, und nachdem er diese beiden Grenzen auf sämtlichen Thermometern angegeben hatte, wurde die Hälfte des gefundenen Abstandes noch unterhalb des Punktes in dem Gefäss mit Eis zugefügt, und der ganze Abstand wurde in $22\frac{1}{2}$ Teile geteilt, unten anfangend mit 0, sodann $7\frac{1}{2}$ Grad für den Punkt im Gefäss mit Eis und $22\frac{1}{2}$ Grad für denjeniges des blutwarmen, welche Teilung ich auch bis zum Jahre 1717 verwendet habe, nur mit dem Unterschiede, dass ich jeden Grad noch in 4 kleinere teilte. Und in dieser Weise waren auch die 2 Thermometer geteilt, über welche der Herr Professor Wolf in den Acta Lipsinia Anno 1714 mense Augusto berichtet. Da diese Teilung wegen der gebrochenen Zahlen unbequem und nicht angenehm ist, beschloss ich die Skala zu ändern und statt $22\frac{1}{2}$ oder 90, 96 zu verwenden, deren ich mich nachher stets bedient habe und welche, obwohl dieselbe eine zufällige ist, wie ich fand, wenn auch nicht völlig, dann doch annähernd mit der Teilung des Thermometers übereinstimmt, welches im Pariser Observatorium hängt. Nachdem ich so die erste Grundlage zur Verbesserung der Thermometer bei Hrn. Roemer gelegt hatte, fing ich an einige Bücher über Barometer und Thermometer zu lesen, und da ich hörte dass in den Französischen Memoiren der Académie des Sciences hierüber viel mitgeteilt wurde, legt ich mich mittels einer guten Grammatik und eines Wörterbuchs auf das Studium der Französischen Sprache, welche ich auch wegen des Latein in kurzer Zeit so weit beherrschte, dass ich die Schriften des Societät zu lesen und übersetzen vermochte, wodurch mir dazu ein grosses Licht in meinen Augen aufging, unter welchen dann hauptsächlich die Abhandlungen von Maraldi, de la Hire, und Amontons viel beigetragen haben, speziell der letztgenannte, weil er sich sehr grosse Mühe gegeben hat den Thermometern eine feste Unterlage zu geben. Von den Engländern, welche über das Barometer geschrieben haben, habe ich nur Boyle's Schriften gelesen, so weit dieselben ins Lateinische übersetzt sind, diejenigen der Societät habe ich niemals zu lesen angefangen als zum ersten Male im Jahre 1724, als ich als Mitglied aufgenommen wurde. Seit jener Zeit habe ich es so weit gebracht, dass ich auch deren Schriften lesen und zum grössten Teil verstehen kann. Die sind somit Kurz gesagt die Mittel, durch welche ich auf den Weg der Verbesserung gelangt bin, womit ich hoffe dass Eurwohlgeboren zufrieden sein werden. . . . "

mately, though not exactly, with the division of the scale of the thermometer that hangs in the Paris Observatory. After I had in this way obtained from Herr Roemer the first basis for an improvement of thermometers, I set about reading some books on barometers and thermometers, and as I heard that much concerning them had been reported to the French Academy of Sciences, I undertook the study of French with the aid of a good grammar and a dictionary. On account of [my knowledge of] Latin, I had in a short time so far mastered it that I could read and translate the papers of the Academy.

There has been much dispute (*1*, *2*, *3*, *4*, *18*) regarding the definition of Roemer's thermometric scale and the origin of the strange number ($7\frac{1}{2}$) assigned to the ice-point. As has already been seen, it appears quite certain that the $7\frac{1}{2}$ is an experimentally derived value, and that the lower fiducial point is intended to be, at least approximately, at the extreme low temperature of a water-ice-NH_4Cl mixture. The procedure here described by Fahrenheit throws additional light on the subject.

It will be noticed that the temperature of the warm bath is exactly 15 of Roemer's degrees above the ice-point, and that 15 is exactly one-fourth of the range of his 60° thermometer. And the zero is exactly half of this 15 below the ice-point, thus placing the ice-point above the zero by exactly one-eighth of the entire range from zero to the boiling-point.

These successive halvings remind one of Roemer's procedure in determining the approximate equivolume lengths of a conical tube, as given in *Adversaria*. In that, he halves the whole, then halves the halves, then halves the quarters. Possibly he was accustomed to using a 1-to-2 proportional divider. The amount of work he expended in deriving approximate formulas for an expeditious determination of the successive lengths indicates that he was impatient of exact computations that were long and laborious, and replaced them, if possible, with shorter, more expeditious, approximate ones. All of which suggests that the $7\frac{1}{2}$ may have been arrived at in a similar way, and was adopted for a similar reason.

That reason is not far to seek. As remarked by Fahrenheit (*12*), the experimental realization of the lowest temperature attainable with a water-ice-NH_4Cl mixture is difficult; and is more difficult in warm weather than in cold. The faster the ice melts, other things being the same, the lower is the concentration of the salt in the water adjacent to the ice, and the higher the temperature of the mixture. The uncertainty so caused must have been very annoying and time-consuming in the adjusting of thermometers; and Roemer's apparent temperament would lead him to seek a more expeditious method for inferring approximately that temperature from another that could be determined more readily. Such a temperature is the ice-point, which he found to lie above his lower fiducial point by approximately one-eighth of the entire range of his 60° scale. Consequently, he placed his zero so that it was exactly one-seventh as far below the ice-point as the boiling-point was above the latter. That, in his opinion, placed it sufficiently near the temperature of the water-ice-NH_4Cl mixture for all practical purposes. Such an inferring of the position of his zero greatly expedited the work, and increased the concordance between the several thermometers so adjusted. And it was entirely satisfactory if the relation used was correct. But if the relation were in error, then his lower fiducial point would cease to be defined by a natural phenomenon (the lowest temperature of a water-ice-NH_4Cl mixture), and would become merely that temperature which lies below the ice-point by an amount that is exactly one-eighth of the difference between his two fiducial points. By reference to Table 2, it will be seen that his zero lies at 6.3°F., and so is a rather poor approximation to the low temperature of the ice-salt mixture.

Much discussion (e.g., *1*, *2*, *3*, *4*, *7*, *14*, *18*, *19*) has also arisen over Fahrenheit's statement that the $22\frac{1}{2}$ bath was at blood-heat. It may easily be seen that $22\frac{1}{2}$ on Roemer's 60° thermometer corresponds to 83.4°F., approximately, where, as elsewhere in this paper, °F. refers to the Fahrenheit scale of today. We now call 98.6°F. blood-heat, which is markedly

higher than the temperature corresponding to $22\frac{1}{2}$ on Roemer's scale. But that does not tell the entire story. The question is this: What would be the reading on the scale of today of the temperature that Roemer regarded as blood-heat? To that question we have no answer, unless it be Fahrenheit's statement regarding the $22\frac{1}{2}$ bath. A similar question arises regarding the temperature which Fahrenheit regarded as blood-heat. Such questions have been quite generally overlooked in discussions of the older scales.

One thing, however, is certain. There were only two ways in which Fahrenheit could have used Roemer's $22\frac{1}{2}$ in graduating his own thermometers. Either he must have known of a natural phenomenon, realizable in Amsterdam, that yielded that temperature, or he must have had a thermometer, carried back with him to Amsterdam, with which he had determined the temperature of the $22\frac{1}{2}$ bath. There is no indication in the letter, or elsewhere, so far as I know, that he had such a thermometer. And he states most explicitly that he understood that the bath was at blood-heat. There seems to be no doubt that he relied on that understanding to enable him in Amsterdam to reproduce the temperature of Roemer's $22\frac{1}{2}$ bath.

Whether Roemer told him that the bath was at blood-heat, thus indicating that he thought that temperature to have the very low value of 83.4°F., or whether Fahrenheit either misunderstood Roemer or jumped to the conclusion that the warm bath was at blood-heat, it is impossible to determine with certainty. But in accordance with what has just been written in reference to the $7\frac{1}{2}$, I am inclined to think that the $22\frac{1}{2}$ point was determined solely by the condition that it should lie above the ice-point by exactly one-fourth of the total range of Roemer's 60° thermometer. If such were the case, then Fahrenheit was mistaken in thinking that the temperature of the $22\frac{1}{2}$ bath was blood-heat.

Actually it makes very little difference whether or not Roemer did regard the bath as being at blood-heat. If he did, then Fahrenheit's scale would not agree with his unless each man accepted the same actual temperature as blood-heat; and it will presently be seen that they could not have done so. If Roemer did not regard the bath as being at blood-heat, then again Fahrenheit's scale could not have agreed with his except by accident, because of Fahrenheit's mistaken impression that the bath was at blood-heat. In spite of Fahrenheit's very laudable desire to make his scale accord with Roemer's, such an accord was necessarily absent unless each man accepted 83.4°F. as blood-heat; and Fahrenheit certainly did not accept that value.

In the letter to Boerhaave, Fahrenheit states that prior to 1717 he denoted the ice-point by $7\frac{1}{2}$ and the temperature which he accepted as blood-heat by $22\frac{1}{2}$, "which division I also used until the year 1717." "Since this division is inconvenient and inelegant on account of the fractional numbers, I decided to change the scale, and instead of $22\frac{1}{2}$ or 90, to use 96, which I have done ever since."

Like his other writings about the graduation of his thermometers, this is decidedly vague—perhaps intentionally so, for commercial reasons. Just what does the last quoted sentence mean? A mere multiplication by 4 removes the fractions. What change, or changes, did he actually make? Did he merely designate by 24 (or 96) the mark that had previously been designated by $22\frac{1}{2}$? Or was blood-heat thereafter supposed to be denoted, not by the $22\frac{1}{2}$ mark, but by a higher one, to be designated by 24? Was the thermal size of a degree the same after the change as before? Relying solely on the information given in the letter, no one can be sure of what he actually did. The difficulty lies in the fact that two points are necessary for defining his scale, and he writes of only one.

But the problem is not entirely insolvable. One can make a very fair guess as to how he determined and numbered his initial scale. Furthermore he states in his letter (written in 1729) that he was still using the later (1717) scale at that time, and there seems to be no known record indicating that he ever changed that scale. Hence it seems fair to assume that the Fahrenheit scale of

today, except for a possible factor of 4, is the same as his 1717 scale; and so one can reason back to his earlier scale and conclude with fair certainty exactly what change he did make. That may be done as follows:

In accordance with his understanding of Roemer, he graduated his early thermometers in terms of the temperature of the ice-point and of that of blood-heat (as understood by him), choosing the size of the degree so that exactly 15 lay between those two points, and assigning to each division a number reckoned from a zero supposed to correspond to the lowest temperature of an ice-salt mixture and placed by inference at a point that was half as far below the ice-point as that was below the division corresponding to what he thought was blood-heat. And following Roemer's procedure, he determined the position of the blood-heat mark by immersing the new thermometer in a bath adjusted in terms of an auxiliary thermometer. By using always the same thermometer for adjusting the bath, he obtained a high concordance between his several thermometers. It is known that Fahrenheit devoted much study to thermometers. He considered the effect of changing the glass. He studied discrepancies between mercury and spirit thermometers. So it is not at all unreasonable to suppose that he studied the lowest temperature of the mixture of water-ice-NH_4Cl, and the temperature of blood-heat as observed in different warm blooded animals and under different conditions; and that, as a result of such studies, he found that blood-heat (defined as the temperature in the mouth or armpit of a healthy man) was higher than he had previously thought, seeming to be about 16 of the degree divisions of his thermometer above the ice-point, instead of 15, as he had previously supposed; and that the temperature of the ice-salt mixture lay a little more than the assumed $7\frac{1}{2}$ divisions below the ice-point. Hence, he accepted 16 for the first; which, with Roemer's one-half relation, led to 8 for the second. That is, he lowered his zero by one-half, thus raising by the same amount the numerical designation of each of his other degrees and eliminating the halves from the numbers that correspond to the ice-point, to blood-heat, and to the boiling-point; and the 16th degree above the ice-point (i.e., his 24th degree) he called blood-heat.

If this guess is correct, then reckoning back from the Fahrenheit scale of today, one finds that his new scale of 1717 was either that designated in Table 2 as °F. or F.″ (i.e., one-fourth of °F.), and that his earlier scale was $F.' = F.'' - 0.5$.

Whence it appears that the Fahrenheit scale of today resulted from blunders. Fahrenheit's letter seems to indicate quite clearly that he initially desired to perpetuate Roemer's scale, but he did not obtain from Roemer the proper definition of the temperature of Roemer's warm bath. His mistaken belief that it was at blood-heat led him to the use of a degree that was significantly larger thermally than was that of Roemer's, but not so large as it would have been had he used for blood-heat the higher temperature adopted in 1717. However, when he adopted that temperature in 1717, he retained the same size of degree as he had previously used, but took for the temperature of the ice-salt mixture defining his zero a value 2°F. lower than before, thus retaining Roemer's one-half relation. That gave the Fahrenheit scale of today; at least well within the precision with which he knew the temperature of blood-heat and that of the ice-salt mixture.

One may well ask, as many have done: How did it happen that the boiling-point on such an unplanned scale is an integral number (212) of such degrees? It probably didn't. However, it obviously departed from an integral number by not more than 0.5°F., and that departure could be removed by suitably changing the thermal size of the degree, the change not exceeding 0.5 in 180, and that would require a shift of the zero by not more than (16/180)°F., the designation of the ice-point being kept unchanged at 32°F. Such a shift of the zero would be entirely negligible as compared with the uncertainty with which the temperature of the ice-salt mixture was known; and the change in the size of the degree would change the numerical designation of the temperature of blood-heat by less than

0.2°F., which is also negligible. Such an adjustment was probably made by some one, possibly by Fahrenheit himself in 1717. True, he says nothing about any such adjustment, but that is in keeping with his secretiveness regarding other details of his work.

It would be interesting to know whether Fahrenheit ever learned that his scales differed from Roemer's (°Ro in Table 2). There seems to be nothing available that throws any light on the subject, nor is there anything to indicate whether he knew Roemer's numerical designation of the boiling-point.

Another possible assumption, in my opinion much less probable than the preceding, is that Fahrenheit did not make any such further study of the temperature either of blood-heat or of the ice-salt mixture, but retained the values accepted in his earlier work, and merely reduced the value of the degree interval, so that 16 new degrees covered the same interval as was covered by 15 of his old degrees, If that were the case, then any given temperature designated by F_1 on his early scale would be designated by $F'' = 16F_1/15$ on his later one (see Table 2).

TABLE 2.—CORRESPONDING TEMPERATURES AT FIXED POINTS ON EACH OF SEVERAL SCALES DERIVED FROM ROEMER'S SCALE.

°F	F″	F′	F_1	$4F_1$	°Ro
	°F/4	F″−0.5	15F″/16		
212	53	52.5	49.69	198.8	60
96	24	—	22.5	90	—
92	—	22.5	—	—	—
83.4	—	—	—	—	22.5
32	8	7.5	7.5	30	7.5
6.27	—	—	—	—	0
2.0	—	0	—	—	—
0	0	—	0	0	—

What then may one fairly infer about what Fahrenheit learned from Roemer? that is, what that might not as readily have been learned from others? Not more than two things: (1) He may have learned the desirability of using a bath adjusted to blood-heat by means of an auxiliary thermometer, rather than of using directly the body or interior of a warm-blooded animal, for determining the position of the top of the thermometer column when the temperature is that of blood-heat. But the advantage of using such a bath is so obvious that it may have been well known to him before he met Roemer. (2) By far the most important, and perhaps the only, thing he learned from Roemer was the idea of inferring the position of the top of the column when at the temperature of the ice-salt mixture from its position at each of two other temperatures—the ice-point and (in his case) blood-heat. The learning of that trick was of extreme importance.

Meyer makes much of the fact that the numbering of the divisions of Fahrenheit's scale suggests Roemer's scale, and of his statement (in the letter) that he initially divided his scale in the same way as did Roemer. But that indicates no more than his recognition of the advantage of avoiding a multiplicity of scales. Roemer seemed to have a satisfactory and reproducible scale; so Fahrenheit decided to make his accord therewith, not because Roemer's was an ideal scale, but simply for uniformity. Unfortunately, apparently on account of a misunderstanding, each of Fahrenheit's scales departed markedly from Roemer's. Consequently, one is scarcely justified in saying, as Meyer does, that Fahrenheit obtained his scale from Roemer.

From all this it seems obvious that although Roemer had clear and correct ideas as to how thermometers should be constructed, (*a*) his work on thermometers was of little importance, because he never published his ideas and never made his thermometers available to others. (*b*) How many thermometers he made is not known, but a note by Horrebow, in *Adversaria*, states that Roemer's widow had given him 5. (*c*) From Roemer's outstanding reputation, one might infer that thermometers made by him were very superior instruments, but the very meager available records are not sufficient to substantiate that inference. (*d*) The principle of defining a thermometer scale by means of two fiducial temperatures was well known long before Roemer's day, having been proposed and used by several throughout the century preceding his work. (*e*) The fiducial points

that Roemer seems to have aimed to use were the lowest temperature of a mixture of water-ice-NH_4Cl, and the temperature of boiling water; but nowhere does he mention any use of the temperature of that mixture. In his later thermometers, that temperature was inferred from the ice-point by means of a none too accurate approximation. (*f*) Fahrenheit did not state in his letter to Boerhaave (April 17, 1729) that he had learned from Roemer the idea of defining the scale by means of two fiducial points. (*g*) Fahrenheit stated that he saw Roemer determining the positions, on certain thermometers under construction, of two fixed points—the ice-point and a point marked $22\frac{1}{2}$, which he (incorrectly) assumed to indicate blood-heat, but he said nothing about either the size of the thermometers or the use to which they were to be put. (*h*, *i*) Fahrenheit stated that he at first divided his scale in the same manner as he had seen Roemer divide his, but he divided each division into quarters. However, as has already been seen, the temperature to which he assigned $22\frac{1}{2}$ was not that to which Roemer assigned the same number. (*j*) Fahrenheit stated that he retained that type of division until 1717, but he did not state that his thermometers were limited in length to $22\frac{1}{2}$ (or 90) divisions. (*k*) He did not state clearly what changes were made in 1717, but as has been shown it is fairly certain that they consisted solely in placing his zero lower by a half of one of his original degrees, and in designating the resulting 24th (or 96th) degree as blood-heat. (*l*) He did not directly state that he retained Roemer's ratio of the thermal intervals between zero, ice-point, and blood-heat, but he did retain it, and he might have expected one so to infer from his statement that he at first divided the scale in the same manner as he had seen Roemer do it. However, the temperatures corresponding to his zero and blood-heat were quite different from those corresponding to Roemer's zero and $22\frac{1}{2}$. (*m*) Roemer did not invent the modern thermometer, the Fahrenheit thermometer has never accorded with Roemer's, and all credit for it belongs to Fahrenheit alone.

With these conclusions compare the following statements composing a section of I. B. Cohen's recent booklet (*5*), mentioned at the beginning of this article. He gives as his authorities Kirstine Meyer (*20*) and the Fahrenheit letter (*7*) and relies somewhat on N. H. deV. Heathcote's summary (*21*) of the latter. They represent Meyer's conclusions, but some are a little more emphatic. For convenience in comparison the several sentences have here been lettered so as to indicate the corresponding statements in the preceding paragraph.

"32. (*a*) Of great importance is Roemer's work on the thermometer. (*b*) Roemer constructed many thermometers and used them in his astronomical work as well as to record the daily temperature. (*c*) These thermometers were designed by him and were superior to any that had been used previously. (*d*) He it was who first realized that the scales of thermometers giving concordant readings must be based on *two* fixed points, not just one. (*e*) The two points he used were the boiling point of water (which he marked 60°) and the melting point of snow or crushed ice (which he marked $7\frac{1}{2}$°), so that a mixture of crushed ice or snow and sal ammoniac would give a zero reading). (*f*) In a letter to Boerhaave in 1729, Fahrenheit (1686–1736) states that he met Roemer in Copenhagen in 1708 and from him learned the fundamental principle of the two fixed points. (*g*) Also, that he saw Roemer in the process of testing small thermometers for meteorological use; these were divided into $22\frac{1}{2}$ parts and had as fixed points $7\frac{1}{2}$° (ice water) and $22\frac{1}{2}$° (blood heat). (*h*) Fahrenheit adds that he himself adopted the same temperature scale, but with two minor changes. (*i*) These were the use of Roemer's zero (snow and sal ammoniac) as the lower fixed point rather than $7\frac{1}{2}$, a convenience pure and simple, and the use of a scale division arrived at by dividing each of Roemer's scale divisions into four such, for ease of reading. (*j*) Fahrenheit kept the scale in this form, with 90 divisions, until 1717. (*k*) At that time, in order to avoid the clumsiness of fractions, he replaced the 90 divisions by 96. (*l*) He 'retained Roemer's general arrangement whereby one-third of the whole range lay between the zero and the melting point, and two-thirds between the melting point and blood temperature; the melting-point thus became 32° and blood temperature 96°' (see Heathcote's article [*21*]). (*m*) Thus it is quite clear that it was Roemer who in-

vented the modern thermometer and that the Fahrenheit thermometer should, in all fairness, be called the Roemer thermometer!"

It will be noticed that nearly every statement in the quoted section is at least misleading, and some are actually false.

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ETHNOLOGY.—*Bird lore of the Eastern Cherokee.*[1] JOHN WITTHOFT, University of Michigan. (Communicated by W. N. FENTON.)

The Eastern Cherokee of Qualla Reservation, North Carolina, are the only large group of the aboriginal peoples of the southeastern United States who still occupy a portion of their native habitat. They represent the only intact ethnic group that is still in daily contact with the country of its ancestors, and with the living creatures that shared that territory. Thus any study of the ethnobiology of the Southeast must emphasize the Cherokee data as of primary importance. This study is intended as one contribution to the understanding of the relationship between man and nature in the southeastern mountains: a relationship that recognized and utilized the members of man's natural environment according to certain patterns and concepts that were basic to the cultures of the area. That relationship has nearly ceased to exist, and we should like to know what were the processes that led to its loss. In an acculturation process, the people's contact with nature and traditional knowledge of the various aspects of natural history may be one of the first constellations destroyed. This may precede the loss of use of the native language and is even a part of it, for the specialized vocabularies concerned with birds, plants, insects, and animals are very readily abbreviated and simplified. It is possible that this instability of nature lore explains the small amount of such information in print for the smaller Indian remnant groups still living in the eastern United States.

The North Carolina Cherokee live on the upper reaches of the Oconalufty River at an altitude of about 2,100 feet, with nearby mountains rising as high as 3,000 feet. This is above the range of chuck-will's-widow,

[1] This study was made possible by a grant-in-aid, for field work among the Eastern Cherokee, from the Department of Anthropology Research Funds of 1944, 1945, and 1946 of the University of Pennsylvania. Received August 30, 1946.

the red-bellied woodpecker, and the shrike. The adjacent mountains are high enough to support pure stands of balsam fir, *Abies balsamea* (L.) Miller. Both the flora and fauna include northern and southern elements of several zones.

Notes on Cherokee bird lore were gathered during three visits to Qualla Reservation in 1945–1946. Data was obtained from about 15 informants, mainly from the towns of Big Cove, Birdtown, and Painttown, but the bulk of the material is from six persons, generally referred to hereafter by their initials. Will West Long (W.W.), of Big Cove, age 75, recognized over 100 Cherokee bird names, all of which he believed to be traditional. He had a good knowledge of the birds about him and was generally able to identify nests and eggs. Mollie Sequoyah (M.S.), of Big Cove, a few years younger than Will, probably knew nearly as many birds, but I did not concentrate on birds when working with her. Her names and traditions agreed very closely with Will's. Cain Screamer (C.S.), of Painttown, age about 55, recognized about 50 bird names, and his knowledge of birds and plants was much less thorough than that of the older informants. Other informants of about his age and conservatism showed a similarly imperfect knowledge of Cherokee natural history. Moses Owl (M.O.), of Birdtown, age about 60, speaks English slightly better than he does Cherokee and knew Cherokee names for about 50 birds, some of which he could recall with difficulty. His knowledge of local White bird names was exceptionally good, and he is a much better naturalist than his Cherokee bird vocabulary would indicate. Jimsie Wallace and Takwat Wallace (J.T.W.), of Adams Creek, Birdtown, father and son, age about 75 and 50, speak little English and are very much men of the woods. They recognized about 60 bird names but probably could give more. Some differences in classification and terminology are noted between the data from Birdtown and that from the Big Cove-Painttown-Wolftown portion of the reservation. Some linguistic differences are also noted between these sections, and it seems probable that an old areal differentiation exists here. Will West Long was in some cases able to recall forms which he had heard in the Oklahoma Cherokee dialect, and I have included them, marked Oklahoma. (This is the western dialect; all the other names are in the middle dialect, the eastern being extinct.)

Most of the work was done over sets of bird plates, the most usable of which was a set of pictures of birds of the Cherokee area selected from the National Geographic Magazine series. Forbush and May's *Birds of the Eastern United States* was found to have better drawings, but the book was too bulky and the pictures of unfamiliar birds tended to confuse informants, so less use was made of this work. Chester Reed's bird guides are the most convenient, but the illustrations are so ill-suited to this purpose that I prefer not to use them—too much confusion results.[2] Dead specimens of birds I happened to find were used whenever possible, and names and data were obtained on the live birds I saw when with informants. I utilized the local English names as much as possible. The authority for most of the Cherokee bird names and for most of the folk material is indicated in this study by the initials of the informant (in parentheses); where no authority is given there was general agreement. The small amounts of data derived from other informants than the ones listed were included in their information, and so have not been indicated. The more pronounced phonetic variants are also included to indicate variability and in the hope that they may some day be of use to the linguists studying Cherokee.

Birdlife was of considerable significance to the Cherokee. Birds had their place in Cherokee religion, folk practice, and medicine, and the content of the folk traditions would indicate that the Cherokee found considerable esthetic interest in them. But the use of birds and their eggs as food overshadowed all other considerations. In the lean winter months birds of all types were caught on the snow with a baited cage-fall or board-fall trap set with a figure-four

[2] My own identifications and the terminology used in this paper are based upon Roger Tory Peterson's *A field guide to the birds*. Boston, 1939.

trigger or a pull-stick trigger. In summer, birds were shot out of trees with a blowgun, caught in traps, and driven out of brush heaps at night with torches and beaten down with sticks. These birds were roasted over the fire and eaten out of their skins. Children and other persons in the woods and fields gathered edible plants, mushrooms, frogs, edible insects, and bird eggs and nestling birds. These were either eaten on the spot or carried home for a meal. The Catawba of South Carolina cooked small birds into meat pies, such game being frequently their only food, but the Cherokee always roasted their birds. According to Will West Long, hawks, owls, eagles, buzzards, crows, wrens, whippoorwills, and kingfishers were not eaten, but all other birds were. The head of the crossbill was not eaten because it tasted strongly of balsam, but the body of the bird was eaten. Needless to say, birds and eggs are now rarely hunted for food, but the older informants gathered much of their bird lore by killing and eating most of the kinds about them. This may partially explain the exceptionally large number of birds recognized and the bulk of folklore pertaining to them, and may indicate one reason why this knowledge is not being perpetuated.

Besides the fall-traps, special traps for turkeys and eagles were known. Will West Long's older sister made noose traps for small birds from strands of her hair, but Will does not remember how they worked. The blowgun (tuʔgwesʻdi′) was a major hunting implement. It was made of an 8- to 14-foot piece of cane, bored and smoothed inside, and was hung by one end when not in use. The darts (dzidzi—the name of the thistles with which they were tufted—*Cirsium* spp.) were about 9 inches long, made of hickory or of stems of the bush clover (*Lespedeza capitata* L.) and wrapped with thistledown and bound with thread at one end, the other end being pointed. With this weapon birds were shot as they were feeding or resting and were not disturbed by the sound of the darts. According to Moses Owl, the shaft of a dart was held across the lips as an aid in imitating bird calls. Even rabbits (struck in the neck), squirrels (struck in the eye), and frogs and toads were taken with the blowgun. A Cherokee could kill a robin at 40 feet with a blowgun.

Earlier Cherokee studies by James Mooney and Franz Olbrechts included random notes on Cherokee bird lore, some of which are referred to later in this paper.[3] A. L. Pickens published two lists of Cherokee bird names, drawn largely from the published sources and from Will West Long.[4] The manuscript of his second paper, preserved in the archives of the Bureau of American Ethnology, is of considerable interest because it includes notes by Will West Long on the names he recognizes and the names are written in the Cherokee syllabary.[5] Pickens's studies include a number of names that I have not collected, but I have not checked these with informants and do not know their source. His names are not phonetically recorded, and many of his interpretations are highly improbable.

Djiskwa″ is the general word for bird in Cherokee, but it is almost never found as a part of a compound bird name. Will thinks he has heard a parrot called gawɔʻniʻsgi′ djiʻskwa′, "talking bird," but no other bird names are constructed after this fashion. One of the seven Cherokee clans is called anidjiʻskwa′, "bird people." (The name for bird is both singular and plural, but the clan name forms a plural.) One special group of birds, the sparrows, receives a signal honor, for its members are called djiʻskwayą́, "really a bird, genuine bird."

The "crane," as the herons and egrets are known locally, is called kąskową́, this being the generic name (W.W.). The "white crane" is probably the American egret, *Casmerodius albus egretta*. The great blue heron, *Ardea herodias*, called skotʔski, per-

[3] Mooney, James, *Myths of the Cherokee*. 19th Ann. Rep. Bur. Amer. Ethnol.: **1**. 1900; *Sacred formulas of the Cherokees*. 7th Ann. Rep. Bur. Amer. Ethnol.: 301–397. 1891. Mooney, James, and Olbrechts, Franz, *The Swimmer Manuscript*. Bull. Bur. Amer. Ethnol. 99. 1932.

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haps referring to "feathers on head" (W.W.), is generally referred to merely as kąskową́ (kąnskową́, C.S.; kąskawą́ kalaskową́, J.T.W.). The little blue heron, *Florida caerulea*, and other wading birds were not recognized by my informants. The great blue heron, at least, was shot and eaten by the Cherokee when it wandered into their territory (M.O.).

The Cherokee seem to have very little knowledge of waterfowl, probably because of the upland, well-drained country in which these people lived. All geese, both wild and domesticated, are called s'as'a or sas'ɑ. In Birdtown ducks are called a^{t}dɔ·ni', but the people of the Big Cove and the adjacent settlements use a different name, kawɔ·nɑ. In Birdtown one variety of a^{t}dɔ·ni', the teal, known locally as "dart apple," has received a distinguishing name, ekskwayę'. One variety of domesticated duck, the Muscovie duck, locally called skogi' duck (i.e., Muskogie duck), is named djokskwɑni' in Birdtown.[6] All other ducks are known by the generic name, and the different varieties do not seem to be distinguished by any qualifying adjectives.

The general name for hawk is tɑwɔ·di', a term generally used instead of the specific name of each hawk. Diga·k^{ʔ} dą'nɑhigą', "long tail," is the sharp-shinned hawk, *Accipiter velox*, and probably also Cooper's hawk, *Accipiter cooperi;* both are called locally "marsh hawk" and "chicken hawk." The red-tailed hawk, *Buteo borealis borealis*, is called uwes'ɬɑ'oski, "love sick," because his note is such a lonely whistle. (He says ju!ju! jijijijiji skwe!, according to Will.) He is locally called "mountain hawk" and "chicken hawk" and is known also as tawɔdɛhu', "hawk big" (W.W.), utą^{nu}tɑ'wɔ·di', "big hawk" (J.T.W.), and tɑwɔ·dɛgwą', "hawk big" (C.S.). Big Cove is named tɑwɔdįhi'', "hawk place" (W.W.).

The red-shouldered hawk, *Buteo lineatus lineatus*, is known locally as the "brown rabbit hawk" and is called gido·diski', "live thing on ground, he snatches up" (W.W., J.T.W.). Will believes that this name may have originally referred to the golden eagle and that it does not properly apply to this hawk. The red-shouldered hawk is invoked in one of the conjurors' formulae to carry away disease.[7] The marsh hawk, *Circus hudsonius*, has simply a name, ga'lonudzi'.

The broad-winged hawk, *Buteo platypterus platypterus*, called "pigeon hawk," is considered a fast and most graceful bird and is called s'ɑnɛ·wá (Oklahoma form—tlɑnɛ·wa') or s'ɑniwǫ'nǫ'; the name is said to mimic the sound of his flight.[8] A giant variety of this bird, called by the same name (specifically referred to as s'ɑnɛ·wɑ'.u·tɑnɑ', "pigeon hawk big"), is one of the most important birds in the Cherokee mythology. Like the giant snakes, these birds were well remembered by all Cherokee and are frequently referred to as having been recently exterminated.[9] One rock cliff on the Tennessee River was known as sɑnɛ·wɔhi' ("pigeon hawk place"). A pair of these giant birds once had a nest there. One of them carried off a live man to their nest, and he ate and slept with the young birds. When the old birds were home he was under constant and hostile surveillance and got no food, but when they were away the young birds fed him and played with him. They taught him a dance, in which he impersonated the hawk pursuing and catching pigeons. When the young birds were large enough to fly he attempted to escape on the back of one of them. When it had flown a distance from the nest, he struck it on the head with a club, stunning it. The bird glided to earth, and he escaped. The dance he learned is still known to the Cherokee and is called the pigeon dance (W.W.). James Adair, a

[6] The Creek Indians, southern neighbors of the Cherokee, also distinguished this variety of duck by a separate name, fu'tc'o.su'li, "duck-buzzard" (Loughridge, R. M., and Hodge, D. M., *Muskogee Dictionary:* 139. 1890). This bird may have been an early introduction among the southeastern Indians.

[7] Mooney, *Sacred formulas:* 356.

[8] All sorts of difficulties are involved in identifying the bird that an Indian informant recognizes. Will identified pictures of the pigeon hawk, *Falco columbarius columbarius*, as this bird, probably because he was misled by a local name, and the plates were, unfortunately, labeled. The tail of this hawk which he and Mollie brought me later, however, belonged to a broad-winged hawk. Many of the identifications in a study of this sort remain somewhat uncertain.

[9] Mooney, *Myths:* 315.

trader among the southeastern Indians in the mid-eighteenth century, has recorded what apparently is a reference to this tale. He says that the Cherokee disliked miserliness and lack of hospitality and had a proverb or jibe that they said of inhospitable people, "Sinnawah na' wora', the great hawk is at home." (This phrase is in the extinct Eastern Cherokee dialect.)[10]

The eagles are known as awɔhuli", which Will interprets as meaning "across the highest mountain." Will says that this name is used only for the bald eagle, *Haliaeetus leucocephalus leucocephalus* (awɔ·hɔli" C.S.; awɔ·hɑli', J.T.W.).

The eagle was a most important bird to the Cherokee and was a symbol of peace. The Eagle Dance, equivalent of the widespread Calumet Dance, was a men's performance in which several dancers carrying gourd rattles and dance wands decorated with eagle feathers pantomimed eagles with conventionalized steps, this dance being emblematic of peace. Several good early descriptions of such a dance with eagle tails exist.[11] This dance was performed to welcome visitors and to greet the dead eagle when it was carried into the town. Eagle tails were highly valued, and the killing of an eagle was a considerable undertaking.[12] Formerly special officers were entrusted with this job. They called the eagle to them with spoken charms and memorized formulae and then shot the bird. This could only be done in fall, else the rattlesnakes, not yet in their dens, would be angered by the Eagle Dance songs and attack people, and an early winter might also appear. The body of the slain eagle might bring disease to those who handled it, and so it had to be left untouched for four days (W.W.). The body had to be beaten all over with a stripped sourwood (*Oxydendrum arboreum* (L.) DC.) switch to drive off the diseases before it was touched (M.O.). As far as I know, the last eagle to be shot on the reservation was killed about 1937.

Jimsie and Takwat Wallace described an eagle trap unknown to my other informants. A number of long poles were driven into the ground to form an open tipi-like structure, with an opening at one side covered by a sliding door of sticks. This door was propped up by a stick, and a string ran from this stick to a hiding place nearby, where the trapper lay in wait. A small animal, such as a groundhog, was tethered by a string to a stake inside of the trap. An eagle, attempting to catch the animal, would pursue him into the trap and would be caught when the hunter pulled the string. I am not at all sure that such a device would work, but it may possibly have been used in some Cherokee communities.

The last eagles in the Big Cove were killed by a white man in the 1890's. A colony of bald eagles had lived there, unmolested except for an occasional individual killed ritualistically, up to that time. Will had taken an eagle according to the prescribed manner in his youth. Abel Blankenship, a white man who claimed Indian descent and was thus permitted to hold one of the better farms in the Big Cove, contracted with a live-animal dealer to sell him a live eagle. He set a trap, presumably a steel trap with the jaws wrapped in cloth fastened to a baited pole-perch, and caught an eagle. Figuring that two eagles were better than one, he trapped the entire colony of 12 and put them in a chicken-wire pen. The live-animal dealer was never seen again, and the eagles died in their cage.

John Taylor ("Old Man Ducksoup," deceased), of Birdtown, described to Moses Owl a peculiar Eagle Dance performance he had seen in his youth. A group of men painted as one kind of eagle and wearing eagle tails, masks, and claws was approached in a dance by a man and woman similarly disguised as a different kind of eagle. In this dance the woman was surrounded and carried off by the other men, but her partner finally was able to maneuver her away again. We have no other data on such a dance or on similar costumes,

[10] ADAIR, JAMES, *History of the American Indians:* 16. London, 1775. Another variant of the Roc myth occurs among the Seneca Iroquois of New York as the origin legend for the Eagle Dance (W. N. Fenton).

[11] TIMBERLAKE, HENRY, *Memoirs*: 107. London, 1765. MOONEY, *Myths*: 281, 492–493. WILLIAMS, S. C., *Early travels in the Tennessee country:* 126. Johnson City, Tenn., 1928.

[12] MOONEY, *Myths:* 281, 283–284, 453.

but the whole performance is suggestive of certain copper and shell art objects from the mounds of the Creek area, in which men painted and garbed like several different species of conventionalized raptorial birds are portrayed in various sequences of a dramatic performance.

The osprey, *Pandion haliaetus carolinensis*, called "fish hawk," is known as kanu'djuʰʷa'', "lucky at fishing" (W.W.) (kanɛ'djuwą́, J.T.W.; konag'iwą', C.S.; kanątsu'wa'', M.S.). According to Will, the fat is tried out from the fish hawk's throat, mixed with *old* bear oil, and drunk as a cure for tuberculosis. The outermost feather (primary) from the right wing of the fish hawk is burned, powdered, and steeped in water; this is drunk for the same purpose.[13]

The sparrow hawk, *Falco sparverius sparverius*, is called g'i·g'i, because he says, according to the Cherokee, g'ig'ig'ig'ig'i. He is considered one of the prettiest of the hawks. Another hawk, called giya'giya', is mentioned in some of the conjurors' formulae, but the Cherokee now apparently know nothing of i s identity.[14]

The turkey vulture, *Cathartes aura septentrionalis*, is called su·'li'. This is also the Creek (Muskogean) name for this bird.[15] The Cherokee are impressed with the "buzzard's" immunity against disease, offensive odors (which are considered possible causes of disease), and corruption. Drinking the blood of the buzzard is said to give temporary immunity from all epidemic diseases (W.W.). A dead buzzard hung somewhere near the house is thought to have a similar effect. In one of the conjurors' formulae, buzzard's down is prescribed as a dressing for shot and arrow wounds.[16] The buzzard was once a handsome and proud bird, and one Cherokee story tells how he fell to his present low station in life.[17] It is also claimed that when a feeding buzzard sees you staring at him he vomits up everything in his stomach in your direction.

The ruffed grouse, *Bonasa umbellus monticola*, is known locally as "pheasant" and is called tą'di·sti', "hear" (gatadiya', "I am hearing (now)"; datadisti', "I hear (habitually)"). If a pregnant cat eats any of the meat or entrails of a partridge, it is believed that the kittens will die within her. To prevent this the cat is made to drink a decoction of the leaves of the patridge berry, *Mitchella repens* L. (W.W.). Mooney records a similar Cherokee taboo against eating grouse, applied to pregnant women.[18]

The bobwhite, *Colinus virginianus virginianus*, is called locally "partridge" and "quail" and is called ᵏᵒkwe (W.W.) or g'ugwe' (M.S.), perhaps in imitation of its call. The bobwhite once had no call, but got his whistle from the tortoise by trickery.[19] The guineafowl is called ᵏᵒkwe dagа'nasa·i'', "quail domestic" (W.W.), or kokwehi' (J.T.W.), or merely ᵏᵒkwe (C.S.). This bird is considered as a sort of watch dog to scare off intruders, and Will tells me that the guineafowl is most valuable because it warns of the approach of witches, especially of invisible ones.

The wild turkey, *Meleagris gallopavo silvestris*, is almost exterminated in the Cherokee area but was formerly an abundant and important bird. Both the wild and domesticated turkeys are called kana'. (According to Jimsie Wallace, the domestic turkey is kana'ɩna'ge·nehi', "turkey domesticated.") Will thinks that the wild turkey was also kept as a domestic bird in aboriginal times and says that his mother gathered wild-turkey eggs and hatched them under a chicken, handling them in leaves and being careful not to touch them herself.

There is more hunting lore concerned with the turkey than with any other bird. The turkey hunter knew certain memorized formulae with which to charm his prey; and

[13] This bird is also invoked by the conjuror as a piercing agent to carry off disease (Mooney and Olbrechts, *Swimmer Manuscript:* 190–191, 266).

[14] Mooney, *Formulas:* 382.

[15] Loughridge and Hodge, *Muskogee Dictionary:* 12.

[16] Mooney, *Myths*: 266. Mooney and Olbrechts, *Swimmer Manuscript:* 72, 272.

[17] Mooney, *Myths:* 293. Witthoft, John, *Some Eastern Cherokee bird stories.* Journ. Washington Acad. Sci. 35: 179. 1946.

[18] Mooney, *Myths:* 295.

[19] Mooney, *Myths:* 289. Witthoft, *Bird stories:* 178.

often wore a mask of bobcat fur made to look like the face of a bobcat. According to Will, who has killed turkeys this way, the turkey was not frightened by what appeared to be a bobcat looking over a stump or around a tree trunk. These masks were also used to hunt bobcats and were worn in certain dances. A small tube of bird bone, one end held in the mouth and the other between the cupped hands, could be sucked to make a good imitation of a turkey's gobble (W.W.).[20] But the best and most curious turkey call was used in Birdtown. A slip of cane or bone, sharpened to a chisellike edge, was set in a corncob. A flat sheet of shale was held over the cupped left hand, and the scraper, held perpendicular to the shale, was scratched across it. By varying the shape of the left hand and the stroke of the scraper, a very close imitation of the turkey's call could be produced. This instrument was called kuna'yeli'st'di', "turkey scratch like" (M.O.).

Several types of traps were used for turkeys. In the Big Cove, a trench about 10 feet long was dug, slanting down from ground level at one end to about 3 feet deep at the other, and about 3 feet wide. Corn was scattered over the floor of this trench for several days, so that the turkeys would overcome their suspicion of this new feature in the landscape. Then a 3-foot-square pen of poles was built up like a log cabin, over the deep end of the trench, and covered with poles, there being large spaces between all the poles. The trench was again baited, and a turkey following the trail of corn with his head down came to the end of the trench, put his head up, and was caught. It is said that he would just stand there and poke his head out through the spaces in the pen, never thinking to bend over and go out the way he came in. All my Big Cove informants vouch for this trap, but the Birdtown people are vastly amused at such an impossible scheme.[21]

According to Moses's father, Adam Owl, turkeys were taken in Birdtown by means of a baited wooden hook on a string. The details are forgotten, except that the points of the hook expanded when the string was under tension.

The Cherokee once no doubt wove feather mantles in which turkey feathers were used, but no memory remains of such a usage. The "beard" (vaneless neck feathers) of the turkey was used as a fringe around the top of some of the single eagle feathered Cherokee headdresses. This "beard" was once the property of the Tortoise's wife, but the Turkey traded the Tortoise some worthless beads for the neckpiece.[22] A bone tube made of the thigh bone of the turkey was used by Cherokee doctors to blow certain medicines on the body and into the throat of a patient. There is no evidence that the Cherokee ever used the turkey spur as an arrowpoint.

According to Will West Long, sandpipers are called kanastu·'wa', "they put their legs in water," but Jimsie and Takwat Wallace insist that this name refers to the killdeer, *Oxyechus vociferus vociferus*. The name is preserved in several of the memorized formulae used for curative purposes. Will calls the killdeer, dj'osto·wa', and tells of a medicinal formula in which red, white, brown, and blue birds of this name are invoked to cure a patient suffering from stomach trouble. Gulls are known at u^{t}li, which also means "turnip"; this name is also preserved in some of the formulae. The "snipe" (Wilson's plover, *Pagolla wilsonia wilsonia*, and the woodcock, *Philohela minor*) is known as gala'sǫyaha', "bill dragging on ground," but Will thinks this name is properly applied only to the woodcock.

The mourning dove, *Zenaidura macroura carolinensis*, called "turtledove," is known as gule'dɨskon'jhi', "acorn he cries for," because the bird is thought to call gulɛ', gulɛ', "acorn, acorn." This name is also thought to

[20] SPECK, FRANK G., *Remarks on Izikowitz's "Musical Instruments of the South American Indians,"* Ethnos **2**: 94. 1937.

[21] Similar traps have been described for Delaware and Rappahannock groups. See: DODGE, ERNEST S., *Notes from Six Nations on the hunting and trapping of wild turkeys and passenger pigeons*. Journ. Washington Acad. Sci. **35**: 342. 1945.

[22] MOONEY, *Myths:* 287. WITTHOFT, *Bird Stories:* 179.

refer to the passenger pigeon, *Ectopistes migratorius*, but an older name for this bird, wɔ·yi′, is preserved in several of the memorized formulae, and Henry Timberlake, in 1765, gives "woey" as the name for the pigeon.[23]

The yellow-billed cuckoo, *Coccyzus americanus americanus*, is known as da^{tl}^{a}ga′, that being the Cherokee imitation of his call (W.W., M.S.). Jimsie and Takwat Wallace call this bird djustig'iski′.

The owls are of some importance in Cherokee folklore and are generally considered birds of ill omen. Jimsie Wallace gives me the name uguku'tawɔ·di′, "barred owl, hawk," for the barn owl, *Tyto alba pratincola*, but my other informants recognize neither the bird nor this name. The screech owl, *Otus asio naevius*, is called wahahu′, in imitation of its call, and is considered rather an inoffensive bird. One Cherokee family takes its name from this bird. (Sally Owl, of Birdtown, for example, was really named sa·li" wahahu′.)

The barred owl, *Strix varia*, is called uguku, in imitation of its call. According to a popular Cherokee story, this bird was once a human being. He courted and married a Cherokee girl, but only came to the house at night and sat in the corner with his head turned, so that his wife and mother-in-law never saw his face. One night the old woman decided to play a trick on him, so she threw an armload of sumac sticks on the fire. When they began to flare up and explode, the husband was startled and turned to look. The girl and her mother saw his face, and began to laugh at him, saying, "Oh, what a funny looking thing you are!" The husband was so offended and ashamed that he ran off into the woods and has remained there ever since as an owl.

Moses Owl, whose name is actually mos'i' uguku', tells a somewhat different version of this story. Once a strange and beautiful bird appeared in the woods, and all the other birds gathered around and began to perform tricks and show off to attract her attention. She paid no attention to any of them, but she noticed one bird, an owl, just sitting there and looking off shyly in another direction. She went over to take a look at him and decided that she would marry the owl. "That," concludes Moses, "is how I got my wife," stealing a glance at his magnificent wife who came from Laguna Pueblo.

The long-eared owl, *Asio wilsonianus*, is the most dreaded of birds.[24] Variously considered as ill omen, witch, or avenger of breach of taboo, this owl is called s'ə'ki·li′, in imitation of its voice, a word which is also considered to mean "witch, wizard, something repulsive, simulator" (W.W.). The scream of the long-eared owl brings dread and terror to the heart of the conservative Cherokee, but the bird must not be killed.

The whippoorwill, *Antrostromus vociferus vociferus*, is almost as hated as the long-eared owl, and its cry is an ill omen. Witches are believed often to appear as whippoorwills. This bird is named waguli", because the Cherokee hear its call as wa'guli", wa'guli", wa'guli". When I showed Will a picture of this bird, he said, with obvious disgust, "Isn't that an awful ugly-looking bird; did you ever see anything uglier?" The whippoorwill is neither killed nor eaten. The nighthawk, *Chordeiles minor*, is locally called "bullbat" and is named ka'lsto·ga′. No special folklore is associated with the nighthawk.

The chimney swift, *Chaetura pelagica*, locally called "chimney sweeper," is known as ^{a}ni'gostayi′, "they are sharp" (W.W.) (nigɔ·stayę′, C.S.; negosta'i′, J.T.W., M.O.) This bird is noted for its speed and agility and is invoked by the ball player and a certain feather from its left wing worn in the hair to give swiftness in the ball game or in war (W.W.). According to Moses Owl, if this feather pointed upward the wearer was peaceably inclined, but if concealed in the hair and pointed downward the wearer was looking for blood. Moses also tells me that birds were invoked in some of the memorized love formulae, considered certain methods for catching the fancy of a girl. Some of these formulae consisted of songs to the chimney swift, cardinal, and blue jay. The aspiring young man sang one

[23] Timberlake, *Memoirs:* 71.

[24] Witthoft, *Bird Stories:* 180.

of these songs in the hearing of the girl; if she looked at him, she was caught; if not, he had to try something else. Certainly a rather neat formality, if not effective magic!

The hummingbird, *Archilochus colubris*, is called wa·lɛ·ɬu′, which has some reference to rolling. (Wheel is dagwe'lɛ·lu′; W.W.) The kingfisher, *Megaceryle alcyon alcyon*, known as "kingfisher" or "woodhawk," is named tsatlɔ′ (W.W.) (ts'atlɔwi′, J.T.W.; ᵈzatla·wa′, C.S.) because his call is interpreted as tsatlalala. A magical (spirit) kingfisher of the same name is invoked in certain formulae used by fishermen. The kingfisher is considered a symbol of piercing power and is therefore invoked in several medicinal formulae (W.W.). The beak of the kingfisher was given him by the Dwarfs or Little People as a reward for assistance he once gave them.[25]

The yellow-shafted flicker, *Colaptes auratus*, is called "yellowhammer" and named unɛ·'gada′, "white dirt." Will says this is because the bird is frequently seen on the ground eating insects, when his rump shows up as a white blotch against the soil. The pileated woodpecker, *Ceophloeus pileatus*, is called the "wood hen" and is considered a lazy and stupid bird. Its Cherokee name is derived from its call, ᵏᵃkwoki′ (W.W.) (u?wɔ·ki′, J.T.W.; ?ko?kwokwa′, C.S.; kwaga′, Carl Standingdeer). The red-headed woodpecker, *Melanerpes erythrocephalus*, is considered a swift and cunning bird and is the great war symbol of the Cherokee; similar woodpeckers were very important in the war-symbolism of many other peoples in North America, the symbolic ornamentation with woodpecker scalps by the Plains tribes being one of the more conspicuous usages. The red-headed woodpecker was always invoked for aid by the ball player and is named in imitation of its call, dala′la′ (W.W.) (dalala′, J.T.W.; dalala′, M.O.; tłała′ła′, C.S.).

The yellow-bellied sapsucker, *Sphyrapicus varius varius*, is named dzuli.ɛna′, "deaf," and is generally referred to as "red-headed woodpecker," this local name also including several other birds. According to one story, this bird was once an old woman, who was deaf.[26] The downy and hairy oodpeckers are called djiskwɛ'nuᵈza′ (W.W.) (t'iskwe'nudja′, J.T.W.; g'iskwɛnuᵈza′, C.S.), a name that may include the generic term for bird (djiskwa′).

The kingbird, *Tyrannus tyrannus*, is noted as a fierce and brave bird and is called diᵗłɛ′gwa′, "big skunk," because the Cherokee think that is what he says (diᵗłɛ, "skunk," and ɛgwa′, "big") (W.W.). The great crested flycatcher, *Myiarchus crinitus boreus*, is called gala′sgalu', in imitation of his cry, gala′s, gala′s (W.W.). James Mooney collected a medicinal formula in which this bird is invoked but did not identify the bird; Olbrechts has identified it as the bittern.[27]

The Cherokee recognize two varieties of phoebe, one the phoebe, *Sayornis phoebe*, the other the wood peewee, *Myiochanes virens*, both of which are called u·lɛ'ladạ′, "lost." This bird was once a person, who was left behind by his friends and is still wandering around in the woods, calling sk'i·'ktida', "wait for me" (W.W.). The least flycatcher, *Empidonax minimus*, is known as skowaya'ᵏᵃto·sti′, "looking for flies" (W.W.).

The bank swallow, *Riparia riparia riparia*, has a proper name, tso'yaga′. Will remembered another swallow, now rare, called djɔ·yagago'la·nehi′, "swallow, winter lives," which appears to be the rough-winged swallow, *Stelgidopteryx ruficollis serripennis*. The barn swallow, *Hirundo erythrogaster*, is called udi'gwanˡᵘzugi′, "notch, crotch, fork" (plural, dzunadi·'gwaˡᵘzugi′; the "nock" of an arrow is udigwạnskwa′, W.W.).

The purple martin, *Progne subis subis*, locally called "black martin," is called tsu·tsu, in imitation of its call (tlu·tlu, Oklahoma form; tjutju, J.T.W.). As far as I could discover, the Cherokee of Qualla Reserve did not put gourds in trees or on poles as nesting boxes for these birds, although Whites and Negroes in many parts of the South do so, and Alexander Wilson, in 1819, noted a similar practice among the

[25] MOONEY, *Myths:* 288–289.

[26] WITTHOFT, *Bird Stories:* 177–178.

[27] MOONEY, JAMES, Manuscript no. 2235 in Bureau of American Ethnology Archives. Mooney and Olbrechts, *Swimmer Manuscript:* 248.

Choctaw and Chickasaw Indians, near neighbors of the Cherokee.[28]

The blue jay, *Cyanocitta cristata,* is named after the sound of its voice, tsas?ᵘga′. The raven, *Corvus corax principalis,* is called kɔlaną́, a name with a similar origin. An invisible raven whose voice is heard from the empty sky is believed to represent a transformation of the worst sort of witch, the dread "raven imitator."[29] The raven must once have held an important place in Cherokee tradition, for Timberlake, an early traveler among the Cherokee, noted that the second most important honorary title, "Colona, or the Raven," a "war-title," was conferred on a man who had killed an eagle and returned with its tail.[30] The crow, *Corvus brachyrhynchos,* also has an onomatopoeic name, koga′.

The chickadee, *Parus carolinensis,* is named tc'igalili, in imitation of his call. He is recognized as a friendly bird and often stays near the house and sings. Sometimes, however, he appears suddenly and whispers "tc'ihi, tc'ihi," then flies away, thus announcing that "company is coming," a stranger or someone you haven't seen in a long time. When I first met Will West Long, he claimed that my visit had been foretold by a chickadee. The tufted titmouse, *Baeolophus bicolor,* is called utzugi′, "crest," and is familiar to all Cherokee as "the bird that lies," because of his role in a story. According to Mollie Sequoyah, this bird sometimes foretells a visit in the same way that the chickadee does, but he is lying. Jimsie Wallace also knew this bird by an alternate name, ali·tegidá.

The chickadee and the tufted titmouse play central roles in the story of the Liver Eater, and much of the tradition concerning them centers about several variants of this tale. Cain Screamer's version, which is especially detailed, follows.[31]

Once there was a man among the Cherokee who destroyed people in order to eat their livers. He had a long, hard index finger, which he would thrust into their bodies to extract the liver, and he was able to simulate the appearance of anyone he pleased and thus no one knew when he was around. His unfortunate victims met what they thought was a friend or relative, only to have him take on his own form when they were defenseless, and they died without being able to tell who he was. Once some of the conjurors detected him in his disguise, but he proved invulnerable. He told them, "You can't kill me because you don't know my name. I haven't any end as long as you don't have my name."

A man who was hunting in the woods with his dog killed a deer and made camp for the night. A stranger appeared and ate supper with them. When the man noticed that the stranger was eating the bones along with the meat, he realized who it was and he and the dog slipped off and began to run away as fast as they could. The Liver Eater ran after them and they were forced to hide in a hollow log. He followed their scent to the stump and began to tap the wood with his hard finger. When he came to the opening, the dog kept putting his nose in front of the finger, so that he was unable to find the hollow, and finally gave up and when off. When he appeared at a dance, the dog recognized him and someone asked him, "What is your name?" Without thinking, he answered, "Usti'i'."

The people then began to make plans to kill him. They got all the animals and birds to help them and to keep track of this criminal. Then, when they knew something of his habits, they dug a pitfall on a path which he often followed. He fell into their trap and all of the people, birds, and animals quickly gathered around. He assumed his own shape and began to grab with his long finger at anyone who came too close to the edge of the pit, The people shot arrows at him, but he just brushed them off. They asked the animals how he could be killed. The Tufted Titmouse said, "Shoot him in the head," but the head proved especially tough. They called the Titmouse a liar, and cut out his tongue. Then the Chickadee offered to find his vital spot, and he flew around the monster, avoiding the thrusts of the long finger. Finally this bird came back

[28] BENT, A. C., *Life histories of North American flycatchers, larks, swallows, and their allies.* U. S. Nat. Mus. Bull. 197: 490–491. 1942.

[29] MOONEY, *Myths:* 283–294. 401. MOONEY and OLBRECHTS, *Swimmer Manuscript:* 206.

[30] TIMBERLAKE, *Memoirs:* 71, 81.

[31] For a bibliography of variants of this tale, see: WITTHOFT, *Bird Stories:* 177.

and told the people to shoot him in the hand, just at the base of the long finger. This killed the monster. The people caught the Chickadee, who was a very plain bird, and painted him as a mark of his valor, making him a much prettier bird. The Liver Eater was buried in the pit. Years later some conjurors dug into his grave, and found his finger, which they thought they could use as magical paraphernalia. Suddenly people began to die mysteriously, and so the finger was reinterred and the deaths ceased.

The white-breasted nuthatch, *Sitta carolinensis* (and probably other nuthatches), is called dɑwaɛyɑlo′^{hi}, "climbing up and down on a round thing" (W.W.; J.T.W. give tuwe·yu'lɔ'ɑhi′). The brown creeper, *Certhia familiaris americana*, is classified by the Cherokee as a woodpecker and called atɑ'go·luni′, "tracking wood."

The house wren, *Troglodytes aedon*, is another bird often seen in the vicinity of Cherokee cabins and is called ganu'la'tsi, which, according to Will, may mean "ribs." The winter wren, *Nannus hiemalis hiemalis*, is called tsi′tsi, in imitation of his note, tsitsitsitsi (W.W.). The Carolina wren, *Thryothorus ludovicianus*, is named ali'tama′, the name that most of the Cherokee seem to use also for the other wrens. This wren is locally called "rainbird," and, according to the Cherokee, when it is going to rain he calls for a drink by saying sku′dj'a', sku′dj'a'; when it is going to clear he calls dji·′la', dji·′la', "fire, fire."

The mockingbird, *Mimus polyglottos polyglottos*, is an uncommon bird in the Cherokee locale. According to Will it is called tsuskǫ'.digis'ski′, "head eating," because the head of this bird, eaten, is said to make a person clever and intelligent. The catbird, *Dumetella carolinensis*, is called u^{t}zimɑ′ (W.W.; utc'imɑ′, C.S., J.T.W.), "not smooth." (Sweet corn is also called unitzimɑ′ (plural), because the ear does not have a smooth surface like the local Indian varieties.) The brown thrasher, *Toxostoma rufum*, is called wati'yɛ·lɑ′, "imitator."

The robin, *Turdus migratorius*, is called tcisgwa′gwa′, in imitation of his voice. The wood thrush, *Hylocichla mustelina*, is named kawɔ·ʔgɑ′, probably onomatopoeic, and is commonly known as the "swamp sparrow." Some of my informants tended to use this name for several other birds with which they were not familiar. The bluebird, *Sialia sialis sialis*, is called dsa'gwolɑdeʔ′ (W.W.) or djagwo·li′ (J.T.W.), both forms referring to his song, which the Cherokee interpret as gwo, gwo, gwo. The blue-gray gnatcatcher, *Polioptila caerulea caerulea*, is called di·si′ because he is heard to say di'is, di'is.

The golden-crowned kinglet, *Regulus satrapa satrapa*, is called atsilɑ′.usti'li', "fire on head" (W.W.). The ruby-crowned kinglet has a proper name, t'a'tsala'gɑ′, and Will notes that this bird does not winter at Cherokee. The cedar waxwing, *Bombycilla cedrorum*, is called u·nɔ·yi′ (C.S. gives a plural, uni·nɔ·yu′), "sand," because it is said that the bird whispers this word, which also describes the soft colors of his plumage. (J.T.W. gives another word for this bird, kɑnɑs'e'hɔni′, which I am unable to analyze.) The vireo, *Vireo olivaceus* and *Vireo griseus*, is called djɑ'tesnali′, "stripe on eyes," according to Will; he also includes several warblers under this name. He notes, however, that this bird builds a little hanging nest in the fork of a tree branch.

The warblers represent the most confused family of birds to the Cherokee. Most of the informants recognize few of these birds, and most of the specific names are on the authority of Will West Long. The Wallaces give a generic name for this type of bird, yǫndɑ'gediski′. Cain Screamer refers to them as udo·ni′, while the Wallaces use this term for the purple finch and probably several other birds. The best known bird of the group is the yellow-breasted chat, *Icteria virens virens*, known locally as the "yellow nightingale" and called hu′hu′ in Cherokee. This bird appears in spring just at plowing time, and there is a popular story about its arrival.[32]

The black-and-white warbler, *Mniotilta varia*, is called djugɑ'tsala′la, "striped on face." Will also tells of a large mythical bird of the same name and appearance,

[32] Mooney, *Myths:* 288.

which flies only at night and comes down from the mountains to get the sunflower seeds when they ripen. The worm-eating warbler, *Helmitheros vermivorus*, is called k'i·yu·gi', "chipmunk," because its head is marked like a chipmunk's. The Blackburnian warbler, *Dendroica fusca*, is called ga·nɑ?g'i', "falling down to the ground," because, Will says, he dives to the ground if you throw a rock at him. The chestnut-sided warbler, *Dendroica pensylvanica*, is named tuya', which also means "bean." The ovenbird, *Seiurus aurocapillus*, Will calls tsu^{tsu}tsɬɔtɑ', "he has a camp." The hooded warbler, *Wilsonia citrina*, is dɑ'ktɛstɑ^{l}li', "spot on his face." The redstart, *Setophaga ruticilla*, is better known than the smaller warblers and is called awɔ·hɑ'liyusti', "like an eagle" (also by an abbreviated form of the name, awɔ·lɑdę''). The water thrush is locally called the "branch bird" (a branch being a small mountain stream), but I could discover no Cherokee name for it. Will could not remember a name for the yellow warbler, *Dendroica aestiva aestiva*, but interpreted its call as go'dɑdɑ'·

The meadowlark, *Sturnella magna*, is generally called nɔkwisi'', "star," from the appearance of its tail in flight, but Will says that it also has a proper name, uni'gwɛlusti'. The orioles, *Icterus galbula* and *Icterus spurius*, are called wɔlɑdɛ, and Will notes that there are two varieties, large and small, and that they build a woven, hanging nest. The grackle, *Quiscalus quiscula*, called blackbird, is known as skwe'listɑ'' (W.W.) (gwalisti', J.T.W.). The red-winged blackbird, *Agelaius phoeniceus*, and the cowbird, *Molothrus ater*, go by the same name but are also specifically referred to by Will as skwe'li·stɑ'' igo·tehi', "grackle living in swamp" (plural, skwe'li·stɑ'' igo·tanehi') and skwelistɑ' sakonage'i', "grackle bluish," respectively. The Wallaces have a special name for the cowbird, sɔ·yidɑ'. The grackle and the redwing are considered the same species by some informants.

The scarlet tanager, *Piranga erythromelas*, and also the summer tanager *Piranga rubra rubra*, are called tso·^{ha}la (W.W.) (ts'ɔ'^{u}li' J.T.W.), a name closely resembling the word for tobacco (tso·la') but seems to have no special significance. The cardinal, *Richmondena cardinalis*, is known merely as "redbird" and named tɔtsu·wa' (tɔdjuwɑ' is more usual), because it says tɔ'tsu', tɔ'tsu'. One Cherokee myth explains the origin of the redbird from the transformed daughter of the sun.[33] The rose-breasted grosbeak, *Hedymeles ludoviciana*, is known as kayɑ'skalɛ·nɑ', "big beak" (plural, ditayɑ'skalɛ·ná; W.W.). The indigo bunting, *Passerina cyanea*, is called ali'tsɑnoskɑ'', "broiling charcoal," an attempt to describe his song, according to Will. The purple finch, *Carpodacus purpureus purpureus*, is not a familiar bird to most Cherokee, but the unusual appearance of this bird has resulted in its name, u'dzo·nɛdą', "perfumed," according to Will. The pine siskin, *Spinus pinus pinus*, found in small flocks in these mountains, is named ałgi·ski, "boiling" (plural, anałgi·ski', "they are boiling"), an attempt to describe the unique call of this bird. Will notes that a flock sounds like a boiling pot.

The goldfinch, *Spinus tristis tristis*, usually called golden finch, yellowbird, or flaxbird, is named wad'agɑ'. This bird is noted for its delicacy, and informants remarked that it was easily caught in thistles, spiderwebs, and similar material. One slightly sticky plant, the Herb Robert, *Robertiella robertiana*, is named wad'aga'dɑgani'iski'', "goldfinch, he catches, grabs." Wataga River, in Tennessee, is probably named for this bird, as was a Cherokee town.[34]

The red crossbill, *Loxia curvirostra pusilla*, is known to few Cherokee, but, according to Big Cove informants, it is resident in the highest zones of the mountains and sometimes comes down to the Cove in October, when it is easily lured to the house-yard by salt. This bird was known as a^{ha}yuga'lǫhi', "twisted mouth" (W.W.), and its head was not eaten.

The towhee, *Pipilo erythrophthalmus*, has an interesting local name, Jori·', but

[33] Mooney, *Myths:* 245.

[34] Bartram, William, *Travels through North and South Carolina:* 352, 373. Philadelphia, 1791.

its Cherokee name is tso·wic'g'a'; both names are imitations of the bird's call. The Jori·' is considered a mean little bird who pulls sprouting corn but is said to be exceptionally good to eat. A mountain and a settlement about 12 miles northwest of Franklin, N. C., noted by Bartram in the 1770's, were named Joree, probably as a translation of this Cherokee bird name.[35]

The junco, *Junco hyemalis carolinensis*, known as the snowbird, is called tu·d'i'. (Oklahoma Cherokee form is tluti'; W.W.) The modern Tennessee Cherokee settlement of Snowbird is named for this bird, the town being situated on Snowbird Creek.

Sparrows are known generically as djiskwayǫ', "really a bird," and only one or two specific sparrows are recognized. The song sparrow, *Melospiza melodia*, is, instead, called ts'ɹk^{t}zo'·^{wa} (according to W.W., the emphatic form is ^{wa}ts'ik^{t}so'wa'), in imitation of its call. Will recognizes two other sparrows: the fox sparrow, *Passerella iliaca iliaca*, called wɔ·ga'ǫda'', and the white-throated sparrow, *Zonotrichia albicollis*, tjunigaʻtagǫhi', "marked on each side of face."

Finally, an introduced domestic bird, the chicken, bears a Cherokee name that is as difficult to analyze or interpret as any of the names for native birds: dzatana' (W.W.) or djatagǫ' (C.S., J.T.W.), which may be only a Cherokee rendering of its English name.

[35] *Ibid.*: 353, 355, 366, 373.

BOTANY.—*On the identity of* Kokonoria.[1] Hui-lin Li, Soochow University, Soochow, China. (Communicated by Egbert H. Walker.)

In a previous number of this Journal,[2] under the title *Kokonoria, a new genus of Plantaginaceae from Tsinghai Province, China*, Dr. Yi-li Keng and Mr. Kwan-hou Keng describe a new genus and species *Kokonoria stolonifera*. The description is in full and is supplemented by detailed drawings of the whole plant and its various parts, as well as a discussion of its relationships, which readily enable one to make out the identity of the plant in question. It is without doubt *Lagotis brachystachya* Maxim. of the Scrophulariaceae.

The authors were correct in doubtfully placing this supposed new genus in the Plantaginaceae. They mentioned its possible relationship with the Scrophulariaceae. In summarizing the characters of the genus, they notice that it is considerably different from most of the Plantaginaceae, saying that "The genus here described is an isolated one [in the Plantaginaceae], differing from the others in having (1) perigynous flowers with an annular disk giving off two lateral accrescent lobes, (2) subsessile anthers with divergent anther sacs, (3) solitary linear ovules pendulous from the tip of the ovary cells, (4) drupaceous fruits with a 2-celled pyrene, and (5) dorsally compressed but not peltate seeds without endosperm." These points are sufficient to warrant the impropriety of including the plant in the Plantaginaceae, but to seek its taxonomic location elsewhere.

Lagotis is usually placed in the Scrophulariaceae, often in the tribe Veroniceae of the subfamily Rhinanthoideae. It has single-seeded cells in the capsule that mark it as one of the most modified of all Scrophulariaceae. Some authors refer it to the tribe Selegineae, which is mainly African. *Lagotis* is primarily an alpine and Arctic Asiatic genus of over 20 species. It extends from Asia Minor through the Himalayas and eastward to Alaska, there extending to the edge of the continental North American glaciation. There are about 12 species in China, in northern Yunnan, Sikang, Tibet, Tsinghai, and Kansu, in the western part of the country. Two species of the genus are stoloniferous, *L. stolonifera* (C. Koch) Maxim. of western Asia and *L. brachystachya* Maxim. of western China. The latter species occurs at altitudes of 2,500–4,300 meters, from Tibet to Tsinghai and Kansu. The

[1] Received September 19, 1946.

[2] Journ. Washington Acad. Sci. **35**: 374–378. figs. 1–18. 1945.

Messrs. Kengs' plant, "collected on the exposed bare ground of the steppe, near the ruined city of Ch'a-han-chêng, about 30 miles east of Lake Kokonor, Huan-yüan-hsien, formerly known as Tan-kê-erh, Tsinghai Province, August 10, 1944, by Y. L. Keng and son (no. 5286)," is within the range of *Lagotis brachystachya*.

The synonymy of the plant in question can be adjusted as follows:

Lagotis J. Gaertner, Nov. Comm. Acad. Sci. Petrop. **14**: 533. 1770.
Kokonoria Keng & Keng f., Journ. Washington Acad. Sci. **35**: 374. 1945.
Lagotis brachystachya Maxim. Bull. Acad. Sci. St. Pétersb. **27**: 525. 1883 (Mél. Biol. **11**: 300. 1883).
Kokonoria stolonifera Keng & Keng f., Journ. Washington Acad. Sci. **35**: 375. 1945.

Messrs. Keng, working in the interior of wartime China and without access to extensive library and herbarium facilities, were unfortunately not able to consult needed references freely. They have rendered a good service by giving a very complete description with excellent illustrations and a discussion that make identification possible without the necessity of consulting the type specimens. If all presumably new species and genera could be described with this same degree of thoroughness, taxonomic botany would have fewer uncertain names and less confusion. A description that forces the reader to consult the original specimens has indeed defied its very purpose.

ENTOMOLOGY.—*The genus* Neella *Reuter, with descriptions of four new species* (Hemiptera: Miridae).[1]

TSAI-YU HSIAO, Nankai University, Tientsin, China. (Communicated by ALAN STONE).

In 1907 Reuter established the genus *Neella* (genotype: *Eccritotarsus eucosmus* Stål) including three species, viz., *Sysinas floridulus* Distant, *E. eucosmus* Stål, and *E. mundulus* Stål (Ann. Naturh. Hofmus. Wien **22**: 152–154). Bergroth in 1922 transferred *E. lutescens* Stål to this genus (Ark. för Zool. **14** (22): 17). In 1893 Distant described *E. vultuosus* from Frontera and Teapa, Mexico. I have identified this species from a few specimens collected at Veracruz, Mexico, and consider it as congeneric with *Neella*. From the collection of Neotropical Miridae in the U. S. National Museum I have discovered four more new species, which are described below.

This genus is very close to *Tenthecoris* Scott, but the body is more elongate, with costal margins of hemelytra nearly parallel, vertex flat or somewhat concave. The rostrum is long with short but not distinctly thickened third and fourth segments. There is no sexual dimorphism as in *Neoneella* Costa-Lima, and the cuneus of female is usually shorter in *Neella* than in *Neoneella*.

[1] Received August 28, 1946.

KEY TO SPECIES OF NEELLA

1. Hemelytra entirely fuscous (except the extreme base) 2
   Hemelytra not entirely fuscous 4
2. Pronotum entirely reddish or yellowish, legs entirely pale, hemelytra explanate posteriorly ..... *eucosmus* (Stål)
   Pronotum fuscous or partly fuscous, legs with at least posterior tibia fuscous or partly fuscous, hemelytra not explanate posteriorly 3
3. Head, pronotal collar, and calli red, antennal segments III and IV pale ..... *mundula* (Stål)
   Pronotal collar and calli fuscous, head also tinged with fuscous; antennal segments III and IV dark ..... *vultuosa* (Dist.), n. comb.
4. Hemelytra unicolorously rufous or flavous 5
   Hemelytra red and dark 6
5. Antennal segment I entirely pale, vertex flat, rostrum reaching apex of intermediate coxae, posterior tarsi pale ..... *unicolor*, n. sp.
   Antennal segment I dark, vertex somewhat concave, rostrum reaching apex of posterior coxae, posterior tarsi fuscous. *lutescens* (Stål)
6. Pronotum without a broad transverse dark band on posterior disk 7
   Pronotum with a broad transverse dark band on posterior disk 8
7. Pronotal disk uniformly red, anterior and intermediate tibia each with apex fuscous, ninth abdominal segment concolorous. *floridula* (Dist.)
   Pronotal disk with a large median fuscous area

reaching posterior margin, anterior and intermediate tibiae unicolorous, ninth abdominal segment fuscous..... *bicolor*, n. sp.

8. Pronotal collar fuscous; dark band on pronotum broad, occupying nearly whole disk; anterior and intermediate tibiae fuscous at apex..... *carvalhoi*, n. sp.

Pronotal collar pale; dark band on pronotum narrow, occupying only anterior half of disk; anterior and intermediate tibiae unicolorous..... *fasciata*, n. sp.

Neella bicolor, n. sp.

Coloration and size similar to that of *N. floridula* (Distant) but with distinct dark area on pronotum, anterior and intermediate tibiae not darkened at apex, posterior tibia with nearly apical half dark, and with ninth abdominal segment dark. Antennal segment II longer and slightly thickened apically. Male genitalia distinct.

Male.—Body oblong, length 4.95 mm, width 2.15 mm, reddish ochraceous with fuscous, color on head, calli, and underside of the body paler; clothed with fine golden simple hairs.

Head vertical, width across eyes 1.16 mm, length seen from above 0.39 mm, height seen from side 0.86 mm; vertex flat, width 0.65 mm. Eyes large, seen from above occupying nearly the whole length of head, divergent posteriorly; frons vertical, slightly convex; clypeus not prominent, slightly curved posteriorly toward apex. Rostrum nearly reaching apex of intermediate coxae, length of segments I:II:III :IV::0.52 mm:0.21 mm:0.21 mm, joint between III and IV indistinct.

Antennae reddish fuscous, length of segment I, 0.56 mm, II, 1.06 mm (segments III and IV missing) (length of antennal segments in the paratype I:II:III:IV::0.56 mm:1.06 mm :38 mm: 0.49 mm, III and IV luteous).

Pronotum, length 0.9 mm, width at base 1.55 mm, at apex 0.77 mm; collar distinctly thicker than antennal segment I; calli transversely rectangular, separated by a deep rounded impression in the middle, their posterior margin not reaching side of pronotum but ended in a deep impression on each side inside lateral margin of pronotum; posterior margin of pronotum slightly concave before scutellum, lateral margins sinuate at middle, humeral angle round, posterior disk finely but distinctly punctate, with a large fuscous spot occupying about the middle third and reaching posterior margin. Scutellum fuscous, width 0.77 mm, length 0.56 mm, triangular, with a distinct broad impression at middle of base.

Hemelytra with embolium linear, slightly convex posteriorly, length of embolium 2.28 mm, inner half of corium, clavus (except basal fifth), and inner angle of cuneus fuscous; cuneus declivent, width 0.86 mm, length 0.9 mm, membrane fuscous, finely rugulose.

The ninth abdominal segment and male genital parameres fuscous; male genitalia with left paramere bent sharply at basal third, basal portion ovate, apical portion much slenderer and pointed at apex; right paramere broad, curvate, tapering and pointed at apex. Legs moderately long, length of posterior femur 1.5 mm, length of posterior tibia 1.63 mm, apical half of posterior tibia fuscous, all tarsi pale.

Types.—U.S.N.M. no. 58082, holotype male, Porto Bello, Panama, March 1, 1911 (E. A. Schwarz); paratype, male, locality and collector same as holotype, March 12, 1911.

Neella carvalhoi, n. sp.

Female.—Body oblong, length 5.03 mm, width 2.02 mm, ochraceous with fuscous, clothed with fine simple flavous hairs.

Head vertical, width across eyes 1.08 mm, length seen from above 0.39 mm, height seen from side 0.86 mm; vertex flat, width 0.56 mm. Rostrum barely reaching apex of posterior coxae, length 1.82 mm, length of segment I 0.52 mm, II 0.91 mm, joint between III and IV indistinct.

Antennae reddish fuscous, length of segment I 0.46 mm, II 1.04 mm, III and IV missing.

Pronotum impunctate, length 0.86 mm, width at base 1.51 mm, at apex 0.69 mm, posterior disk and collar fuscous, extreme humeral angle pale. Scutellum fuscous, triangular, width 0.73 mm, length 0.52 mm, basal impression much broader than that of *bicolor*, n. sp.

Hemelytra with coloration similar to that of *bicolor*, n. sp., emboliar margin very slightly convex, linear, length 2.58 mm; cuneus width 0.77 mm, length 1.03 mm, membrane fuscous.

Legs moderate in length, posterior femur 1.72 mm, posterior tibia 1.94 mm long; apical third of anterior tibia and sometimes extreme apex of intermediate tibia fuscous.

Male.—Color pattern similar to female,

width of head seen from above 1.19 mm, width of vertex 0.49 mm; length of antennal segment I 0.49 mm, II 1.19 mm. Genitalia similar to *bicolor*, n. sp., but the right paramere narrower and much longer and more twisted.

Types.—U.S.N.M. no. 58083, holotype, female, Trinidad River, Panama, June 10, 1912 (A. Busck); allotype, male, San José, Costa Rica (M. Valerio); paratype, female, same data as allotype.

This species is named in honor of Dr. José Candido M. Carvalho, who is energetically expanding our knowledge of the Neotropical Miridae.

Neella fasciata, n. sp.

Male.—Body elongate, length 4.9 mm, width 2.15 mm, ochraceous with reddish and fuscous, clothed with yellow simple hairs.

Head broad, vertical, width across eyes 1.29 mm, length seen from above 0.35 mm, height seen from side 0.78 mm; vertex somewhat excavate, width 0.56 mm, more yellowish posteriorly; frons tinged with reddish, flat; clypeus and jugum red, the former not prominent, discrete from frons on a line connecting lower ends of eyes. Eyes large, prominent, greatly projecting over the pronotal collar. Rostrum yellowish, with extreme apex fuscous, reaching apex of posterior coxae, length of segments I:II:III:IV::0.56 mm:0.63 mm:0.22 mm :0.18 mm (joint between II and III indistinct).

Antennae inserted at lower third of inner margin of eye, linear, length of segments I :II:III:IV::0.56 mm:1.25 mm:0.49 mm:0.69 mm, I and II brownish red, III and IV yellow, much slenderer than I and II, II very slightly thickened toward apex.

Pronotum yellow, with a transverse fuscous band behind calli extending to across propleura; length 0.9 mm, width at base 1.63 mm, width at apex behind collar 0.99 mm, apical collar very distinct, a little thicker than antennal segment I; posterior margin slightly sinuate before scutellum, lateral margin distinctly sinuate, humeral angle rounded, disk with punctures at base of hairs. Scutellum fuscous except base, triangular, width 0.77 mm, length 0.65 mm, impressed at middle of base.

Hemelytra reddish, with costal margins nearly parallel; embolium linear, length 2.37 mm; inner angle of corium broadly, clavus excepting basal fourth, and inner angle of cuneus fuscous, length of cuneus 0.86 mm, width 0.9 mm, membrane fuscous.

Body beneath yellow. Legs moderately long, concolorous, length of posterior femur 1.72 mm, of posterior tibia 1.98 mm. Male genitalia with left paramere sharply bent at basal third, much enlarged at base and tapering toward apex; right paramere broad and rounded at apex.

Female.—Similar to male in coloration, length 5.59 mm, width 2.15 mm. Head with width across eyes 0.86 mm, width of vertex 0.34 mm. Length of antennal segments I:II :III:IV::0.53 mm:1.26 mm:0.49 mm:0.63 mm.

Types.—U.S.N.M. no. 58084, holotype, male, Barro Colorado Island, Canal Zone, October 9, 1940, collected at light (J. Zetek, no. 4691); allotype, female, Barro Colorado Gatun Lake, Panama, August 1923 (R. C. Shannon); paratypes, male, Trinidad River, Panama, May 2, 1911 (A. Busck); female, Porto Bello, Panama, April 21, 1912 (A. Busck); female, Piedras Negras, Costa Rica (Schild-Burgdorf).

Neella unicolor, n. sp.

Female.—Body oblong, uniformly ochraceous except the fuscous antennal segments II and IV and the pale membrane on hemelytra, clothed with concolorous simple hairs; length 4.99 mm, width 2.15 mm.

Head vertical, width across eyes 1.2 mm, length seen from above 0.43 mm, height seen from side 0.73 mm; vertex flat, width 0.56 mm; frons convex; clypeus evenly curved posteriorly. Rostrum reaching apex of intermediate coxae.

Antennae slender, linear, length of segments I:II:III:IV::0.41 mm:1.09 mm:0.55 mm :0.49 mm.

Types.—U.S.N.M. no. 58085, holotype, female, Yurimaguas, Peru, April 7, 1920 (H. S. Parish); paratype, female, Iquitos, Peru, May 5, 1920 (H. S. Parish).

ORNITHOLOGY.—*Three new North American birds.*[1]

HARRY C. OBERHOLSER, Cleveland Museum of Natural History.

In the course of the writer's researches on the birds of Texas, a number of new races of North American birds were discovered. Three of these are described below.

Anthus spinoletta geophilus, n. subsp.

ALASKA PIPIT

Subspecific characters.—Similar to *Anthus spinoletta alticola* Todd, but upper parts somewhat darker, less grayish (more brownish); lower surface paler or more whitish and more buffy (less cinnamomeous); jugulum usually heavily streaked with dark brown.

Measurements (in mm).—*Adult male:* Wing, 78–87 (average, 83.8); tail, 62.5–69 (65); exposed culmen, 11–12 (11.8); tarsus, 21.5–23 (22.3); middle toe without claw, 13–14.3 (13.8); white on inner web of outermost tail feather, 33.5–40 (37.8). *Adult female:* Wing, 75.5–83.5 (average, 78.8); tail, 58–64 (61.3); exposed culmen, 11.5–12 (11.8); tarsus, 20–22 (21.3); middle toe without claw, 12.3–14 (13); white on inner web of outermost tail feather, 29.5–38.5 (33.8).

Type.—Adult male, no. 298525, U. S. National Museum, Biological Surveys Collection; False Pass, Unimak Island, Alaska; May 14, 1925; O. J. Murie; original number, 2950.

Geographic distribution.—Breeds in southwestern Alaska. Winters south to southern Mexico. Casual east to New York, Pennsylvania, and the District of Columbia.

Amphispiza nevadensis campicola, n. subsp.

IDAHO SAGE SPARROW

Subspecific characters.—Similar to *Amphispiza nevadensis nevadensis* but somewhat larger; upper parts darker, more grayish (less ochraceous or buffy); and the flanks also more grayish (less buffy).

Measurements (in mm).—*Adult male:* Wing, 76.5–82 (average, 79.3); tail, 69.5–77 (72.8); exposed culmen, 9.5–11.5 (10.8); tarsus, 20–23 (21.8); middle toe without claw, 12.5–14 (13.5). *Adult female:* Wing, 70.5–78 (73.5); tail, 68–74 (70); exposed culmen, 9.3–10.5 (10); tarsus, 19.8–20.5 (20.3); middle toe without claw, 12.5–14 (13.3).

Type.—Adult male, No. 34892, Cleveland Museum of Natural History; 6 miles south of Hamer, Jefferson County, Idaho; May 16, 1931; Pierce Brodkorb; original number, 6940.

Geographic distribution.—Breeds north to middle Idaho and eastern Washington; west to eastern Washington and central northern Oregon; south to southeast central Oregon and southern Idaho; and east to southern and central Idaho. Winters south to southern California, southern Arizona, and Chihuahua.

Passerella iliaca zaboria, n. subsp.

ALASKA FOX SPARROW

Subspecific characters.—Resembling *Passerella iliaca iliaca*, from eastern North America, but upper parts including wings and tail averaging darker and much more grayish or sooty (less rufescent), the reddish brown spots usually smaller, less numerous, and decidedly duller; markings on the under surface duller, less rufescent (darker, more blackish).

Measurements (in mm).—*Adult male:* Wing, 87–91.8 (average, 88.8); tail 71–77.3 (74.3); bill (exposed culmen), 11–13 (11.8); height of bill at base, 7.8–9 (8.3); tarsus, 24.3–25.4 (24.8); middle toe without claw, 15–17 (15.8). *Adult female:* Wing, 81–86.5 (83); tail, 67–71 (69.3); bill (exposed culmen), 11–12 (11.5); height of bill at base, 7.5–8.7 (8.3); tarsus, 23.3–26 (24.8); middle toe without claw, 14–16 (14.8).

Type.—Adult male, no. 187118, U. S. National Museum, Biological Surveys collection; Circle, Alaska; July 4, 1903; Ned Hollister; original number, 240.

Geographic distribution.—Breeds north to northern Manitoba, Mackenzie, and Alaska; west to Alaska and Alberta; south to Alberta and Manitoba; and east to Hudson Bay. Winters south to Texas, Louisiana, and Florida.

Remarks.—The fox sparrow was originally described[2] without more definite type locality

[1] Received August 29, 1946.

[2] *Fringilla iliaca* Merrem, Avium Rar. Icones et Descript., pt. 2, p. 37, pl. [X]. 1786.

than North America. Since the colored plate and the description seem to indicate that they were derived from a specimen of this species from eastern North America, the name is hereby restricted to the eastern fox sparrow from Quebec. As there is no name available for the western race, it is here named as above.

ORNITHOLOGY.—*A new subspecies of tanager from northeastern Colombia.*[1]

JOHN T. ZIMMER, American Museum of Natural History. (Communicated by HERBERT FRIEDMANN.)

Among other interesting material received from Brother Nicéforo María of the Instituto de La Salle, Bogotá, Colombia, are four specimens of the tanager *Chlorospingus ophthalmicus* that can not be referred to any of the known forms. Since they are consistently different, it is apparent that they represent an undescribed subspecies which is described below.

I am grateful to Brother Nicéforo María for the opportunity to examine and describe this interesting bird and to retain the type in the American Museum of Natural History. I am further grateful to William H. Phelps, of Caracas, Venezuela, for the loan of the type of one of the allied forms, and to the Chicago Natural History Museum for permission to examine important critical material in that institution.

In the following description, names of colors are capitalized when direct comparison has been made with Ridgway's *Color standards and color nomenclature.*

Chlorospingus ophthalmicus eminens, n. subsp.

Type.—From Gramalote, Department of Norte de Santander, Colombia. Amer. Mus. Nat. Hist. no. 748393. Adult female collected in November 1940 [by Brother Nicéforo María].

Diagnosis.—Distinguishable from all the known subspecies of *C. ophthalmicus* by its deep black head, darker than in any of the other forms. In most details it resembles *C. o. nigriceps* of central Colombia, but it has a strong white postocular area lacking in that form; auriculars are no blacker than the top of the head; the throat is less heavily spotted. From *jacqueti* of the Caracas region of Venezuela it is distinguishable by its paler (more whitish) and somewhat more heavily spotted throat, darker green back, and more grayish belly, and by having the auriculars no darker than the crown. From *venezuelanus* of the Mérida region it is separable by its darker cap, paler and less heavily spotted throat, lighter yellow breast, and grayer belly; from *falconensis* of the State of Falcón, Venezuela, it differs by its much paler throat, less olive-green back, paler yellow breast without any brown coloration centrally, grayer belly, and absence of bright brown on the auricular region.

Range.—Known only from the type locality and Páramo de Tamá, Venezuela.

Description of type.—Top of head black without a positive brownish tone; upper malar region and most of auriculars similarly black but with an inconspicuous grayish area on the upper and posterior auricular feathers, separating the malar region from the occiput; loral region dull whitish with black tips; a prominent white stripe extending from near the upper anterior corner of the orbit posteriorly to a point above the middle of the auriculars and broadening behind the eye to involve part of the feathering of the lower eyelid. Back Warbler Green×Olive Green (with dusky subterminal stripes on some of the feathers, not shown by any of the paratypes); upper tail-coverts slightly lighter. Chin and throat whitish, with a slight buffy tinge, strongest on the malar region, and with only moderately prominent dusky tips on the feathers, obsolete on the throat and the posterior malar area; between the throat and the malar region the dark tips are lengthened so as to produce a narrow dark line. Breast Wax Yellow, darkening to Pyrite Yellow on the sides and flanks; belly with light gray centers and white margins, giving a distinctly grayish tone to the region; under tail-coverts with Yellowish Citrine centers and narrow Stron-

[1] Received September 3, 1946.

tian Yellow margins. Wings sooty, with the outer margins of the remiges narrowly green like the back except on the outer primary and the terminal two-fifths of the next three primaries where the edges are light gray; inner margins of the remiges whitish; under wing-coverts pale yellow; bend of wing deeper yellow. Tail sooty, with exposed surfaces about like the back. Bill (in dried skin) black; feet pale brownish. Wing, 74 mm; tail, 60.5; exposed culmen, 11; culmen from base, 14.5; tarsus, 20.5.

Remarks.—Sexes alike. Three other skins from the type locality (one male, one female, and one bird of undetermined sex) show no decided differences from the type. The bird without given sex has the breast very slightly paler than that of the type; the other two have this area slightly deeper. In all, however, the white post-ocular marking is equally prominent, the top of the head is notably blackish, the belly is grayish, and the throat is only lightly buffy and moderately spotted—all characters of *eminens* in this combination. A male from Páramo de Tamá, Venezuela, agrees in essential details.

I am unable to understand the statement by the late Mr. Underdown [Ibis (13) **2**: 651. 1932] that *venezuelanus* of the Mérida region is the darkest-headed subspecies of this group. In the series at hand, *venezuelanus* is exceeded by *nigriceps* of central Colombia as well as by the present form. There might be some suspicion that the specimens of *venezuelanus* now before me had faded sufficiently to reduce the color of the crown to the distinctly brownish hue they now exhibit in that region—a color that is matched by that of the auriculars as it is in *eminens*. However, the throat in *venezuelanus*, though more exposed and more likely to fade than the crown, is deeper in color than in *eminens*, as well as more heavily spotted—characters that are as useful as the hue of the crown in separating these two forms.

Hellmayr [Publ. Field Mus. Nat. Hist., zool. ser., **13** (pt. 9): 403. 1936] has included a locality in the Department of Santander, Colombia, in the range of *jacqueti*, the Caracas form. In view of the existence of the present form and *venezuelanus* in the terrain between Santander and the State of Lara, this record is surprising. The specimens from Santander, however, I find it impossible to distinguish from Trujillo skins of *jacqueti*.

Specimens examined.—*C. o. jacqueti:* Venezuela: Cumbre de Valencia, 3 ♂, 2 ♀; Galipán, 3 ♂, 4 ♀; Silla de Caracas, 1 ♂, 1 ♀; Colonia Tovar, 3 ♂, 2 ♀; head of Chichiriwichi Valley, 1 (?); El Limón, Puerto La Cruz, 1 ♂, 1 ♀; Caripe, 4 (?); Bucarito, Tocuyo, 2 (?); Guamito, Trujillo, 1 ♂[2], 1 ♀[2].

C. o. venezuelanus: Venezuela: "Mérida," 4 (?); Escorial, 2 ♂; Valle, 2 ♂, 1 ♀; El Loro, 1 (?); Hechicera, 1 (?); Conejos, 1 ♂; Montañas Sierra, 1 ♂.

C. o. falconensis: Venezuela: San Luis Mountains, Falcón, 1 ♂ (type)[3]; Curimagua, Falcón, 1 ♀.

C. o. nigriceps: Colombia: Río Toche, 1 ♂; Santa Elena, 3 ♂, 3 ♀, 1 (?); La Candela, 1 ♂; Sabanalarga, 1 (?); El Eden, 1 ♂; Medellín, 1 (?).

C. o. eminens: Colombia: Gramalote, Norte de Santander, 1 ♀ (type), 1 ♂[4], 1 ♀[4], 1 (?).[4] Venezuela: Páramo de Tamá, 1 ♂.[2]

[2] Specimens in Chicago Natural History Museum.

[3] Specimen in collection of W. H. Phelps, Caracas.

[4] Specimens in Instituto de La Salle, Bogotá, Colombia.

ORNITHOLOGY.—*Two new hemipodes from southeastern Asia.*[1] H. G. Deignan, U. S. National Museum. (Communicated by Herbert Friedmann.)

I

A series of 27 specimens of *Turnix suscitator* from central and northern Siam are sufficiently distinct from the races of neighboring areas to justify the establishment of a new form, which I propose to name—

Turnix suscitator thai, n. subsp.

Type.—Adult female, U.S.N.M. no. 332637, collected at Nong (*or* Bung) Boraphet, central Siam (at lat. 15° 43′ N., long. 100° 14′ E.),

[1] Published with permission of the Secretary of the Smithsonian Institution. Received September 30, 1946.

on March 24, 1933, by Hugh McCormick Smith (original number 6195).

Diagnosis.—The new race is, *in series*, easily distinguished from all others of the species by having the prevailing tone of the upperparts *brownish gray*, rather than grayish brown (as in *atrogularis*) or rufous (as in *blakistoni*). It has the bill intermediate in robustness between those of *atrogularis* (Malay Peninsula) and *blakistoni* (southeastern China) and about equal to that of *plumbipes* (Assam).

Range.—Central Siam, south at least to Prachuap Khirikhan (Ko Lak); northwestern Siam.

Remarks.—Birds from Prachuap Khirkhan agree in color with topotypes but have the heavy bill of *atrogularis;* one specimen from the type locality and one from Chiang Mai likewise possess an exceptionally heavy bill.

Examples seen from northwestern Siam average slightly browner than those from Central Siam; it is suggested, however, that this difference would disappear with more material, since Robinson and Stuart Baker, in describing *interrumpens* (Bull. Brit. Orn. Club *48*: 60, 1928) observed that "specimens from N.E. Siam are very gray, and with further material may have to be separated and named." Moreover, a single female from Myitkyina agrees perfectly with certain Siamese birds; thus it seems likely that the name *thai* must be used even for the populations of the Shan States and northeastern Burma.

I have not been able to separate *interrumpens*, the putative form of peninsular Siam, from *atrogularis* of the southern Malay States and northernmost Sumatra. *T. s. interrumpens* was described as being "very uniform in the colour of its upper plumage, having neither the rich red marking of *blakistoni* nor the velvety-black bars and marks of *T. s. suscitator* or *T. s. atrogularis.*" Twelve peninsular Siamese birds before me have the general color of the upperparts grayish brown (as in *plumbipes* and *atrogularis*) and the black markings as strongly present on the average as in any other race.

Of five examples seen from southern Annam, four agree well enough with *thai;* the fifth, a winter-taken female, has the coloration of *blakistoni*, but a much heavier bill, and, in fact, is not too different from a uniquely rufescent specimen of *thai* taken at Chiang Mai.

II

The populations of *Turnix suscitator* found in Java and Sumatra (except Achin) are trenchantly divided from those of Achin and the Asiatic mainland by having the *massive* bill yellow instead of plumbeous, and a well-marked rufous nuchal collar in the adult female. My material indicates that Sumatran birds are not correctly placed under the name *suscitator* (Java), and for them I suggest the name—

Turnix suscitator machetes, n. subsp.

Type.—Adult female, U.S.N.M. no. 181157, collected on the Siak River, east-central Sumatra, on December 20, 1906, by William Louis Abbott.

Diagnosis.—Nearest *T. s. suscitator* but readily separated from it, *in series*, by having the nuchal collar and the ground color of the remaining upperparts distinctly darker in tone.

Range.—Sumatra (except Achin and perhaps the southernmost parts); Bangka; Bilitong.

Remarks.—In this race, as in all others of the species, a single specimen *may* match individual examples of one or more other forms; the distinctions between subspecies are obvious, however, when respectable series are compared.

For the loan of comparative material from several critical areas, my thanks are due the authorities of the Academy of Natural Sciences of Philadelphia and of the American Museum of Natural History.

HERPETOLOGY.—*A subspecies of the lizard* Xantusia riversiana.[1] HOBART M. SMITH, A. and M. College, College Station, Tex. (Communicated by HERBERT FRIEDMANN.)

Specimens of *Xantusia riversiana* illustrated by Van Denburgh (Occ. Pap. California Acad. Sci. **10**: pl. 51. 1922) and by Smith (Handb. Lizards: pls. 89, 90. 1946) indicate a difference in pattern between topotypic material from San Nicolas Island and that from Santa Barbara and San Clemente Islands.

These islands, with Santa Catalina, form a semicircular group of four off the coast of southern California. They comprise the southern group of the Santa Barbara Islands. Santa Catalina is nearest the mainland (20 miles) and is slightly the largest. The southernmost, San Clemente, lies 25 miles south of Santa Catalina and is but little smaller than the latter. The others lie to the west of Santa Catalina; Santa Barbara, a very small island, is about 25 miles due west, and San Nicolas, of intermediate size, is about 35 miles southwest of the latter.

Oddly enough, the species is not known from Santa Catalina Island, although it occurs on all the others and is restricted to them. Santa Catalina is inhabited by some three mainland forms of lizards, possibly four of snakes, and two of amphibians. Only *Xantusia* occurs on the other islands, except on San Clemente where *Uta stansburiana* is recorded. Presence of king snakes possibly accounts for the absence of *Xantusia* on Santa Catalina Island. Regardless of the reason for the absence of *Xantusia*, there is no question that Santa Catalina is markedly different faunistically from the other islands, which have a nearly uniform and almost totally impoverished fauna.

Isolated as are these islands, apparently long distinct from the mainland, it is not surprising that animals in them show some differentiation. It is not improbable that the population of *Uta stansburiana* on San Clemente has differentiated to some degree. Certainly *Xantusia* has done so. The only endemic form recognized at present on any island of the southern group is *Batrachoseps attenuatus catalinae* on Santa Catalina Island. One other, *Xantusia riversiana*, is endemic to the group as a whole. *B. a. pacificus*, restricted otherwise to the northern group of the Santa Barbara Islands (San Miguel, Santa Rosa, Santa Cruz, Ana Capa) has been suggested to occur on Santa Barbara Island by Bishop (Handb. Salamanders: 323. 1943), but this seems very dubious in view of the completely different faunas of the northern and southern groups of these islands (they share only two—*Hyla regilla* and *Uta stansburiana*—in the total of 15 forms, eight others in the southern and five others in the northern group occurring in the entire group). If Bishop's suggestion proves correct it is probable that the name should apply to *B. a. catalinae*.

Specimens available at the present time include one *X. riversiana* from San Clemente Island and three from San Nicolas Island.[2] These differ from one another in at least four respects not obviously subject to individual variation within the total limits observed; it is assumed that further specimens will prove the relative constancy of at least some if not all the differences discerned. Unfortunately, material from Santa Barbara Island is not readily available to me; there is little question, however, that it too will prove to be somewhat different from the topotypes.

It is suggested that the population on San Clemente Island be known as—

Xantusia riversiana reticulata, n. subsp.

Holotype.—U. S. Fish and Wildlife Service no. 9228, collected on San Clemente Island in the summer of 1940; received from C. W. Kern.

Diagnosis.—Similar to *Xantusia riversiana riversiana* of San Nicolas Island except: preanals irregular, smaller; gulars nearly uniform,

[1] Received September 3, 1946.

[2] I am indebted to Francis M. Uhler for the privilege of studying these specimens.

scarcely enlarged medially; pregular fold poorly developed; dorsal head scales exceedingly pitted, corrugated, broken up; dorsolateral light line not evident; dorsal surfaces, including those of legs, boldly reticulated or spotted with black.

Description of holotype.—Dorsal head scales normal, except exceedingly pitted and corrugated, rendering the sutures well-nigh indiscernible; central gulars between the anterior and posterior pregular folds small, 24 from rear of former and front of latter; anterior pregular fold poorly defined, with no more than one or two rows of small scales; largest preanals scarcely wider than widest abdominal plates; preanals not clearly in two rows. No evidence of a dorsolateral light streak; back covered with clear-cut, dark marks, which effect a reticulated pattern; limbs and head reticulated and spotted; tail irregularly lined and spotted above; belly and sides of throat with rather numerous small black flecks.

The holotype is illustrated on plate 90 of the *Handbook of lizards of the United States* (Smith, 1946).

Comparisons.—In the three topotypic *X. r. riversiana* the sutures between the dorsal head scales are clearly apparent, although some pits are present. The central gulars are somewhat enlarged: a longitudinal count of 20 or 21 is obtained from the rear of the anterior pregular fold to the front of the posterior. The anterior pregular fold is well defined and contains three or four rows of small scales. The largest preanals are as wide as two adjacent, small abdominals, and nearly twice as wide as any one of the widest abdominals. The preanals are clearly in two longitudinal rows. All show evidence of a dorsolateral light streak on each side (see pl. 89, Handb. Lizards. 1946); those in which the light lines are less evident have less distinct dark markings. The legs are dimly marked. The belly and sides of the gular region are not or sparsely marked.

Remarks.—In pattern *X. r. reticulata* resembles to some extent the specimen illustrated by Van Denburgh (op. cit.: pl. 51, fig. 2) from Santa Barbara Island. The two populations may be consubspecific.

ICHTHYOLOGY.—*Systematics of an American atherine fish,* Melanorhinus microps (*Poey*).[1] CARL L. HUBBS and LUIS R. RIVAS. (Communicated by LEONARD P. SCHULTZ.)

Among the most distinctive of the many New World Atherinidae are the species that have been referred to *Melanorhinus* and to *Mugilops*. Although it was evident for several years, the conclusion that *Mugilops* Meek and Hildebrand (1923, p. 271) is a synonym of *Melanorhinus* Metzelaar (1919, p. 38) was first published by Myers and Wade (1942, p. 139).

Two species of *Melanorhinus*, both Tropical, are currently recognized, namely *M. cyanellus* (Meek and Hildebrand) of the Pacific and *M. boekei* Metzelaar of the Atlantic. The Pacific representative was treated in detail by Meek and Hildebrand (1923, pp. 271–272, pl. 22, fig. 1), by Myers and Wade (1942, pp. 139–141), and by Fowler (1944, pp. 219–220, 244, 408, 497, fig. 132). Myers and Wade recognized *Mugilops marinus* Meek and Hildebrand as a synonym of *Melanorhinus boekei* Metzelaar. In preparing a supplementary treatise on the marine fishes of Panama, Hildebrand (personal communication) has concurred in this opinion. We now find that the Atlantic species was named much earlier, as *Atherina microps*, by Poey. The synonymy of *Melanorhinus microps* follows.

Melanorhinus microps (Poey)

Atherina microps Poey, 1860, p. 266 (original description; locality not specified, but presumably Habana, Cuba).—Jordan, 1887, p. 571 (West Indies).—Jordan and Evermann, 1896, pp. 789, 791–792 (comparisons; description, after Poey; Havana).—Jordan and Hubbs, 1919, pp. 48–49 (referred to

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 289. Received September 16, 1946. The study was conducted at the United States National Museum, where research facilities were made freely available. The junior author is studying under a John Simon Guggenheim fellowship.

Atherinopsinae, but of undetermined genus).—Jordan, Evermann, and Clark, 1930, p. 246 (Habana).

Melanorhinus boekei Metzelaar, 1919, p. 38, fig. 14 (original description; "oysterpond at St. Martin").—Jordan, Evermann, and Clark, 1930, p. 249 (reference).—Myers and Wade, 1942, pp. 139, 141 (generic position; genotype; synonymy; dorsal spines).

Mugilops marinus Meek and Hildebrand, 1923, pp. 271–272, pl. 22, fig. 2 (comparison; original description; Porto Bello, Panama).

Mugilops marina Jordan, Evermann, and Clark, 1930, p. 252 (reference; "Panama Bay" wrongly given as range and "Porto Bello, Panama Bay" wrongly located as the type locality).

Melanorhinus marinus Fowler, 1944, p. 462 (reference—*M. boekei* overlooked).

Although Jordan and Hubbs indicated in 1919 that it appears to be referable to the New World subfamily Atherinopsinae, *Atherina microps* has remained an unplaced enigma. Now it becomes evident to what genus and species it should be referred. Fortunately, though brief, Poey's description covers a number of crucial characters. In these as in other respects the diagnosis agrees acceptably with the Atlantic species of *Melanorhinus*. The agreement will be appreciated by one who compares with recent descriptions or with specimens of that species the following free rendering of Poey's diagnosis of *Atherina microps:* The small head is contained 5 times in the total length. The body is deep—somewhat deeper than the head is long. The eye is small, 4 in the head length. The mouth is much smaller than in "*Atherina laticeps*" [*Atherinomorus stipes*] and is very protractile. The first dorsal is more anterior than it is in "*A. laticeps.*" The second dorsal and the anal are longer than in that species. The ray formula is "D. 5–1, 15; A. 1, 19." The anus is close to the anal fin. Color is silvery, with the back greenish and the scales partly dotted with brown. The head is rather deep blue and the lateral band is not sharply defined.

The only species to which this diagnosis applies is the one currently called *Melanorhinus boekei*. As Jordan and Hubbs noted, the many-rayed anal fin and the location of the anus close to the anal fin preclude an identification with any of the few American species of Atherininae (recently treated by Hubbs, 1944b). The deep body, the many-rayed second dorsal fin, and the lack of a sharp lateral band confirm this view. All known Atherinopsinae other than the species of *Melanorhinus* are likewise excluded from consideration by the lack of a well-defined silvery band. The dorsal ray formula is also unlike that of any atherinopsine other than *Melanorhinus*. Only that genus and *Notocheirus* Clark (1937, p. 88) have as many as 15 dorsal soft-rays and *Notocheirus* has no spinous dorsal. Other features of form, proportions, and color apply to *Melanorhinus*. Identification with the Atlantic species of that genus is made on the basis of locality, general agreement in all characters and, specifically, the low number of spines in the first dorsal fin (Table 1). The Pacific species, *M. cyanellus*, has 8 or 9 spines in this fin, according to Meek and Hildebrand (1923, p. 272) and Fowler (1944, p. 220).

The only discrepancies between Poey's diagnosis of *Atherina microps* and other descriptions and specimens of the Atlantic *Melanorhinus* are in the number of dorsal spines and of anal soft-rays (Table 1). There may be regional variations in ray number, but since the rays are very small and closely crowded, it is more plausible to assume that Poey, who probably used only a hand lens, made too low a count. Rather high power with good illumination is required for reliable counting.

The approximate variation in ray counts in *Melanorhinus microps* has been determined by counting a series of 28 specimens in the United States National Museum (no. 9432). Though the locality is indeterminable, the identification of this set seems to be assured on the basis of the number of dorsal spines and of the other diagnostic features that were pointed out by Meek and Hildebrand (1923, p. 271). The body depth measures 3.4 to 3.8 times in the standard length (36 to 56 mm). The distance from the caudal base to the dorsal origin when stepped forward usually extends to the tip of the snout or a pupil's length farther forward, rarely almost an eye's length behind or before the snout tip.

In basic fin structure these 28 specimens agree with most other Atherinidae, as recently described (Hubbs, 1944a). The first dorsal fin comprises a cluster of short, flexible spines, well separated from the second dorsal, which, as also the anal, has one short spine, a single unbranched soft-ray and then a series of branched rays. The caudal has consistently 9+8=17

TABLE 1.—FIN-RAY COUNTS IN MELANORHINUS MICROPS

Specimens	Author	Spines in first dorsal fin			
		5	6	7	8
Atherina microps types	Poey	X	—	—	—
Melanorhinus boekei types	Metzelaar	—	X	—	—
Mugilops marinus type	Meek and Hildebrand	—	—	1	—
Mugilops marinus type	Recount	—	—	1	—
U.S.N.M. no. 9432	Original	—	9	15	4

Specimens	Author	Dorsal soft-rays					
		14	15	16	17	18	19
Atherina microps types	Poey	—	X	—	—	—	—
Melanorhinus boekei types	Metzelaar	—	—	X	—	—	—
Mugilops marinus type	Meek and Hildebrand	—	—	1	—	—	—
Mugilops marinus type	Recount	—	—	1	—	—	—
U.S.N.M. no. 9432	Original	2	7	6	10	1	2

Specimens	Author	Anal soft-rays						
		19	20	21	22	23	24	25
Atherina microps types	Poey	X	—	—	—	—	—	—
Melanorhinus boekei types	Metzelaar	—	—	—	X	—	—	—
Mugilops marinus type	Meek and Hildebrand	—	1	—	—	—	—	—
Mugilops marinus type	Recount	—	—	—	1	—	—	—
U.S.N.M. no. 9432	Original	—	5	4	11	5	2	1

principal soft-rays. The pelvic comprises a flexible spine and 5 soft-rays. In the pointed pectoral fin the uppermost ray is very short, the second long but unbranched, and the others branched.

In the National Museum we located seven specimens (no. 37530) labeled "*Atherina microps*? Cuba, 1885, Prof. F. Poey." These, however, are obviously not the cotypes of *A. microps*. In fact, they do not represent the same species. They are largely disintegrated but some retain enough flesh and skin over the posterior sides to show a definite silvery band. Two complete vertebral columns respectively comprise 43 and 44 vertebrae, whereas one of the specimens of *M. microps* in the series of 28 has only 39 vertebrae. Search through the disarticulated bones yields premaxillaries with extroverted dentition, mandibles with elevated rami, and opercles that are quite unlike those of *M. microps* (in *Melanorhinus* the opercle is extremely high and short and the articulating socket is much closer to the upper edge than to the lower). The jaw bones clinch the identification of this series as "*Atherina*" *araea* (we use the binomial, since, on the basis of a higher gill-raker count and other characters, the Bermuda form, *harringtonensis*, seems to be specifically distinct). Scales on the specimens as well as loose ones in the jar are also like those of *A. araea* and in one trenchant feature contrast with the scales of *Melanorhinus microps* and *M. cyanellus*. The exposed field is wholly smooth, whereas this part of the scale in *Melanorhinus* is consistently crossed by many very fine, closely set, almost strictly vertical circuli. In *Melanorhinus*, as in the American Atherininae, in contrast to nearly all Atherinopsinae, the lateral scales are very deep, much higher than long; they have few, almost straight and vertical circuli on the basal field, and they have evenly rounded posterolateral angles and no radii.

Melanorhinus occupies a very isolated position in the family but apparently should be retained in the Atherinopsinae. In the compression of the body, particularly of the belly, in the truncated head, and in the very high pectoral fins this genus is approached by *Eurystole* and *Nectarges* (Myers and Wade, 1942). *Melanorhinus* in turn approaches the most bizarre member of the group, *Notocheirus hubbsi* Clark (1937, pp. 88–90, 1 fig.). All these fishes have characters that appear to be adaptations to surface life in or near the surf. They, and particularly *Melanorhinus*, are close coun-

terparts of the species of the Indo-Pacific genus *Iso*, which, presumably, are of like habits. Furthermore, *Melanorhinus* also matches closely the surface-schooling querimana stage of *Mugil*. The resemblance to the querimanas extends even to the scale structure, which undergoes an abrupt and profound change when the querimana postlarva metamorphoses into the juvenile mullet (Jacot, 1920). In the querimana, as in *Melanorhinus*, the circuli of the apical field are numerous, close-set, and vertical. In each genus this structure appears to enhance the silvery sheen of the scale. *Melanorhinus* and other atherinopsine genera named above appear to have had an origin separate from that of *Iso*, as also, certainly, from that of *Mugil*. The kinships involved seem to be most effectively expressed by referring *Iso* to the Atherininae and by retaining the convergent American genera in the Atherinopsinae. To follow Myers and Wade (1942, p. 140) in separating off a monotypic subfamily Melanorhininae would rather befog the apparent relationships.

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ETHNOLOGY.—*Identification and history of the Small Robes Band of the Piegan Indians.*[1]

JOHN C. EWERS, U. S. National Museum. (Communicated by F. M. SETZLER.)

A few years ago Dr. H. H. Turney-High questioned elderly Kutenai Indians of northwestern Montana and southeastern British Columbia about the other tribes of which they were aware. Among the people who lived across the Rockies to the east of the Kutenai they mentioned the—

Little Blankets (k'tsałmałnána). These people lived in Canada and are said to be related to the Blood, although Chief Kustata denies that they are Blood proper. Most informants think that they were a band of Blood and are now extinct. Being of the Blackfoot group they were, of course, enemies.

Chief Paul disagrees in the identification of the Little Blankets, claiming that they are just the ordinary enemy seen around Browning, that there is nothing mysterious about their identity, that they are just ordinary "South Piegan." (Turney-High, 1941, p. 28.)

In spite of their lack of agreement as to the exact identity of these people, it is apparent that the modern Kutenai referred to the Small Robes (Inuksiks), who were a large and powerful group on the Northwestern Plains little more than a century ago. A number of references to this group as Small Robes, Little Robes, Little Robe's Band, and even as Little Rogue's Band appear in the early literature on the Northwestern Plains region. Since the information on this once important group is widely scattered in meager references, some of which are conflicting, it may be well to bring it together and evaluate it here, and to add such information as we were able to obtain from elderly Indians on the Blackfeet Reservation, Montana, in the years 1942–44, regarding the present numbers of the Small Robes and traditional history of the group.

The earliest reference to the Small Robes was made by the artist-writer George Catlin, who regarded the Small Robes as a separate major division of the Blackfoot group of tribes. Catlin (1841, vol. 1, p. 52) divided the Blackfoot into "four bands or families, as follows: the 'Pe-a-gans,' of 500 lodges; the 'Blackfoot' band, of 450 lodges; the 'Blood' band, of 450 lodges; and the 'Small Robes,' of 250 lodges. These bands constituting about 1,650 lodges, averaging ten to the lodge, amount to about 16,500 souls."

Catlin never penetrated the Blackfoot country, although he did meet some Blackfoot Indians who visited Fort Union in the Assiniboine country on the Upper Missouri in the summer of 1832. Catlin obtained his information on the divisions and numbers of the Blackfoot from the fur traders at the fort. These men apparently considered the Small Robes to be a large and separate major division of the Blackfoot group, comprising some 2,500 persons, or roughly 15 percent of the total Blackfoot population. However, it is well to remember that American traders had a limited acquaintance with the Blackfoot in 1832. Fort Piegan, the first American trading post in the Blackfoot country, had been established less than a year before. Catlin's estimate for the entire Blackfoot group appears high in comparison with the estimates of other and probably better informed, white men.[2]

[1] Published by permission of the Secretary of the Smithsonian Institution. Received November 6, 1946.

[2] See Wissler, 1936. Tables of population estimates pp. 4, 6. The recollections of the aged fur

At an unrecorded date during his half century of contact with the Blackfoot tribes (1804–54), John Rowand, veteran Hudson's Bay Company trader, made an estimate of the population of these tribes. In addition to the "Blackfeet proper, Piegans, Bloods, Gros Ventres or Fall Indians, and Circes," he listed a sixth group, the "Mountain Tribes," comprising the "Cotones" (Kutenai) and Small Robes. He reckoned the combined population of these two "Mountain Tribes" at 250 tents or approximately 2,000 souls. (Hind, 1860, vol. 2, p. 152.)

Father De Smet, who became acquainted with the Small Robes in the early 1840's also considered them a separate tribe of the Blackfoot group. He definitely characterized them as non-Piegan:

> The tribe of the Piegans forms a portion of the six tribes known by the generic name of Blackfeet. The other five are the Blackfeet, properly so called, the Men of Blood, the Sarcees, the Little Robes, and the Grosventres.[3]

At the time of Father De Smet's early labors at the Flathead Mission in the Bitterroot Valley west of the Rockies, the Small Robes were at peace with the Flathead, although the majority of the Blackfoot were hostile. Possibly as early as 1842, the Small Robes visited the mission, became greatly interested in Christianity, and permitted many, if not all, of their children to be baptized by Father De Smet and his associates.[4]

In the year 1845, the Small Robes suffered a severe defeat in a battle with the Crows. Father De Smet mourned their loss in a letter from the west of October 30, 1845 (Chittenden and Richardson, 1905, vol. 2, p. 524):

> The year 1845 will be a memorable epoch in the sad annals of the Blackfeet nation. . . . The Crows have struck them a mortal blow—fifty families, the entire band of the Little Robe, were lately massacred, and 160 women and children have been led into captivity.

Denig (1930, pp. 551–554), the fur trader, probably referred to this action in a statement written in 1854:

> The Crow Indians a few years since, after killing all the men and boys of 50 lodges of the Blackfeet, took prisoners upward of 200 women and children. One of our gentlemen now in charge of that nation was with the Crow camp when the battle took place, and for two or three months afterwards, during which time he sought occasions to liberate about 50 women and send them home to their people.

However, the destruction of the Small Robes was not as complete as Father De Smet at first feared. A dozen lodges of Blackfoot accompanied the Flathead-Nez Percé camp on its fall buffalo hunt east of the Rockies in 1846, during which this allied force met and defeated the Crows in a fierce battle. De Smet complimented the small Blackfoot group on their bravery exhibited in the fight (Chittenden and Richardson, 1905, vol. 2, pp. 578–579):

> The little party of Blackfeet, animated by a spirit of revenge for the loss of half their tribe, massacred the preceding year by the Crows . . . did signal service in the combat.

In view of De Smet's conception of the Small Robes as a distinct tribal division of the Blackfoot, we may conclude that the Blackfoot members of that party must have been Small Robes. De Smet's earlier statement relative to the massacre of the entire tribe should be revised in the light of this later reference to the "loss of half their tribe" in the battle with the Crows in 1845.

Whether a considerable number of the Small Robes men, as well as the women, survived that battle, or whether a portion of the Small Robes were not engaged, we do not know. It is certain that the Small Robes, though greatly reduced in numbers, continued their existence as a group. The fur trader Charles Larpenteur met them south of the Missouri in the summer of 1848. He attempted to obtain horses from them, but they refused, as

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trader Hugh Monroe that the Small Robes numbered "more than one hundred lodges" in the second decade of the 19th century may be nearer the strength of the band in 1832 than Catlin's estimate. See also Schultz, 1927, p. 13.

[3] Chittenden and Richardson, 1905, vol. 3, p. 949. However, Father Nicholas Point, who spent the fall and winter of 1846–47 in the Piegan camps, did not consider the Small Robes a separate division of the Blackfoot group. Footnote 5, same page.

[4] *Ibid.*, vol. 2, p. 593. See McClintock, 1910, pp. 157–166, for a later Indian tradition of the Small Robes' relationship with Father De Smet and their acceptance of Christianity.

they had quarreled with their old friends the Flathead and feared, correctly, that Larpenteur would use the horses to carry arms and ammunition to their new enemy.

> A band of Blackfeet, called the Little Robes, after the name of their chief, instead of following the rest of the tribe north after trade was over, remained on the south side of the Missouri. Some of Little Robe's young men happened to have a fight with the Flatheads; some one of each party was killed and horses were stolen. So the peace was broken and the Flatheads returned to their country as fast as they could. (Larpenteur, 1898, vol. 2, pp. 259–260.)

The peace referred to was the one established through the efforts of Father De Smet in September 1846, between the Flathead and the Blackfoot tribes at the Piegan camp east of the Rockies. Now the Small Robes, who must have been influential in the making of it, were among the first to break the peace.

In 1850, Thaddeus A. Culbertson, on the authority of Malcolm Clark, who was then in charge of the American Fur Company's post at Fort Benton, identified the "Little Robes" as one of the bands of the Piegan (Culbertson, 1851, p. 144). Three years later, J. M. Stanley, artist for the Pacific Railway Survey, included the "Little Rogue's band of 30 lodges" in his enumeration of Piegan bands (Stanley, 1855, p. 449). The sound similarity between "Rogue's" and "Robe's" is so close as to suggest the likelihood that an error was made in recording the interpreter's English translation. Certainly there is no other authority for the existence of a Piegan band by the name of Little Rogue's. Thus, in less than a decade, and primarily as the result of war casualties in a single battle, the Small Robes were reduced from a large band to a group of 30 lodges, much the smallest of the five Piegan bands enumerated by Stanley.

In the winters of 1855 and 1856 the Small Robes were characterized as a group of unwelcome loafers about Fort Benton. The band is mentioned in several brief entries in the Fort Benton Journal (McDonnell, 1940) during that period:

> Jan. 9, 1855. A few lousey Pagans from Little Robes band arrived with a horse and a Robe or two to trade . . . [p. 16].
>
> Jan. 16, 1855. Sent an Indian to Little Robe Camp to see if these Indians had not picked up our horses . . . [p. 18].
>
> Dec. 16, 1855. . . . in the afternoon Camp of "Little Robes" arrived with their Lodges which they have pitched in the Prarie behind . . . [p. 56].
>
> Dec. 18, 1855. Little Robe Band moved Camp and intend settling for the present at Pablos Island to dress what Robes they have . . . [p. 56].
>
> January 9, 1856. A Little Robe Ind. passed with one Robe to trade being all we have got for the past two days . . . [p. 58].
>
> January 13, 1856. The Little Robe band moving Camp from across on "Chantier" looked in to loaf and anoy us but gave us no Robes . . . [p. 59].
>
> January 26, 1856. Some Little Robes paid us another loafing visit for the 100th time . . . [p. 61].

This pitiless description of the remnant of the once powerful Small Robes is in striking contrast to Lt. Bradley's opinion of what might have been their lot had it not been for the battle with the Crows in 1845. Writing 70 years ago, Lt. Bradley said of "the Little Robe band of Piegans" (Bradley, 1923, pp. 281–282):

> At the time the whites first became acquainted with the Piegans (1831), though avowedly a part of the Piegan tribe, they lived wholly by themselves, seldom meeting with the remainder of the tribe and showing so marked a line of separation that by one or two writers they were classed as a separate tribe. Had they not unfortunately suffered utter extermination a few years later at the hands of the Crows, it is probable that long ere this their tribal independence would have been universally conceded.

George Bird Grinnell (1892, pp. 209, 225) identified the Small Robes as a Piegan band. In his diagram of the Piegan camp circle of about 1850–55, he placed the lodges of the Small Robes in the southeastern portion of the circle, indicating that the Small Robes were considered an integral part of the Piegan tribe. Clark Wissler (1911, p. 11) listed the Small Robes as a Piegan band.

In our investigations on the Blackfeet Reservation, Montana, from 1942–44, it was found that only two families, the Day Riders and the Calf Robes, were considered by the older Indians to be members of the Small Robes band.[5]

[5] Research performed under the auspices of the U. S. Indian Service, while the writer was Curator, Museum of the Plains Indian, Browning, Mont.

Mike Day Rider (born 1871), senior surviving member, said that the Small Robes were always a Piegan band, joining the Piegan camp circle each summer for the tribal sun dance. He had "always been told" that the Small Robes had once been a very large band. However, he knew nothing of any disastrous battle with the Crows in the early days or of his people's early interest in Christianity. He recalled that the Small Robes were said to have been more friendly toward the Flathead than other Piegan bands; that the Small Robes had even furnished ammunition to the Flathead for use in fighting the other bands of the Blackfoot. Mike said that the Small Robes broke up as a residential group while the Blackfeet Agency was at Old Agency, about 60 years ago. Lodge Pole, the last chief of the Small Robes, died in the 1890's. Day Rider had not heard of a chief of the band by the name of Little Robe. He recited the following tradition of the derivation of the name of the band:

> A long time ago there was a young woman of this band who was very pretty. Many young men wished to marry her, but she refused them all. Her father asked her to marry a certain young man he had selected for her. Still she refused. Later the young woman found a sweetheart of her own choice. She doubled a year old buffalo calf robe over her head and neck like a scarf and went to meet him. That is how the Small Robes band got its name.

Richard Sanderville (Chief Bull), who is not a Small Robes member, cited additional traditional evidence regarding the history of the band. His version of the origin of the band name differed from Mike Day Rider's:

> The band was named after the peculiar custom of its members of wearing pieces of buffalo robes, smaller than whole robes, as shawls thrown over their shoulders when visiting other bands.[6]

He said that the Small Robes once fought a bitter battle with the entire Crow camp in the Judith Basin country south of the Missouri, and that the chief of the band, who went by the name of Little Robe, died of wounds received in that battle. He had heard that some of the Small Robes women, dressed as men, took active part in the fighting. Sanderville was also familiar with the tradition of Small Robe friendship with the Flathead:

> They were very friendly with the Flatheads, and frequently joined them in hunting buffalo on the plains. At one time, before the 1855 Blackfoot Treaty, the Piegans fought the Flatheads on the Musselshell River. On that occasion the Small Robes helped the Flatheads by supplying them with Piegan ammunition.

Sanderville stated that the Small Robes were always a Piegan band, joining the other bands each sun dance season in the great camp circle. He understood that the Small Robes were once a very large band.

Other elderly Piegan Indians, who were not members of the Small Robes band, believed that it was at one time very large, more friendly toward the Flathead than other Piegan bands, but definitely a band of the Piegan tribe, not a separate division of the Blackfoot group.

CONCLUSIONS

In the early part of the 19th century the Small Robes were probably the largest band of the Piegan Indians. Catlin's estimate of the band's size in 1832 is probably high. We estimate conservatively that the band may have numbered as many as 150 lodges and nearly 1,500 souls before the smallpox epidemic of 1837. Although there is no record of Small Robes losses in that disaster, doubtless their numbers were considerably lessened by that plague. In Father De Smet's time (1844), the Small Robes probably numbered 80 or more lodges. Of these, the men of approximately 50 lodges were massacred in a bitter fight with a large body of Crow Indians in 1845. By 1853, the Small Robes numbered about 30 lodges. Since that date their membership has decreased until, at the present time, only two families of this once powerful band remain—the Day Riders and Calf Robes of the Blackfeet Reservation in Montana.

Because of the large size of the Small Robes band prior to 1845, and their relative independence of action (which was made possible by their numerical strength), the group was considered by Catlin's sources of information, by the experienced Canadian

[6] McClintock, 1923, p. 251: They were called "Small Robes, because of the size of their robes."

trader John Rowand, and by Father De Smet to have been a major division of the Blackfoot group of tribes, distinct from the Piegan. This independence of action was most marked in their friendship for the Flathead, whom most Piegan regarded as tribal enemies. Not only did the Small Robes join the Flathead on their buffalo-hunting excursions on the plains east of the mountains, but also they journeyed across the Rockies to pay friendly visits to the Flathead camps in the Bitterroot Valley. At the Flathead Mission they came under the influence of Father De Smet and his associates, who baptized the Small Robe children in the Christian faith. The Small Robes were probably the first of the Piegan bands to accept Christianity. This was before the Small Robes' crucial battle with the Crows in 1845, which, in one tragic action, reduced the position of the Small Robes from one of power and influence to one of minor importance. Never again did the Small Robes play a significant role in the history of the Northwestern Plains.

Only when we realize that information on the history of other Blackfoot bands before 1850 is practically nonexistent, can we appreciate the significance of this fragmentary sketch of the Small Robes. Had not George Catlin, John Rowand, and Father De Smet failed to recognize the Small Robes' Piegan affiliations, we should know considerably less about the band than we do. In reality, far from being a little-known band, as some writers have suggested, we have greater knowledge of the history of the Small Robes than of any other band of the entire Blackfoot group.[7]

[7] In Larpenteur, 1898, vol. 2, p. 259, footnote, Editor Coues states: "These do not appear to have been a well-known band." Chittenden and Richardson, 1905, vol. 2, p. 524, editors' footnote . . . "they seem to have been little known, and were probably not a large band."

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PALEONTOLOGY.—*A new palaeoniscoid fish from the Lower Permian of Texas.*[1]

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In a recent review of the vertebrate fossils originally described by Fritsch (1879–1904) from Kounova, Czechoslovakia, Dr. A. S. Romer (1945a) demonstrated a striking similarity and essential contemporaneity between this late Stephanian assemblage from Europe and the early Autunian fauna from the Wichita Group of Texas. Of interest in this connection, as mentioned by Romer (1945a, p. 423), is a new palaeoniscoid fish from the Texas formations which is referable with sufficient probability of correctness to the genus *Progyrolepis* Fritsch from Kounova. The remains of ray-finned fishes are notably rare both at Kounova and in the Texas Redbeds. The present description is offered in order to make known not only a genus common to both localities but also only the third addition to the actinopterygian fish fauna of the Texas Permian formations, since that fauna was last comprehensively reviewed by Hussakof in 1911 (Case, 1935; Dunkle, 1939).

The single specimen, on which this report is based, was collected in 1933 by the Museum of Comparative Zoology Expedition of Harvard University. The scattered remains are contained in a highly calcareous, gray clay and were incompletely recovered on a number of weathered pieces of this matrix. On preparation, several of these fragments were found to fit together. The conditions of preservation prevent consideration of general body proportions and little detail can be offered regarding the structure and position of the fins, and the roofing, temporal and opercular series of bones. Discernible with fair accuracy, however, is an obliquely crushed and badly distorted skull, which shows the sphenoidal and orbitotemporal portions of the neurocranium, certain elements of the primary branchial arches, the cheek plates, both upper and lower jaws, the gular plates, and the branchiostegal rays. In addition, there are preserved many disassociated scales from various parts of the body, portions of two fins, and several axial supports.

The specimen was collected by Dr. Theodore E. White, and its study permitted by the courtesy of Prof. A. S. Romer, curator of vertebrate paleontology, Museum of Comparative Zoology.

Superorder CHONDROSTEI
Order PALAEONISCOIDEA
Family PALAEONISCIDAE, s. str. (Aldinger, 1937)
Genus **Progyrolepis** Fritsch (1893)

First mentioned by Fritsch in a faunal list of the Kounova material published in 1883, the species *speciosus* was originally assigned to the Triassic genus *Gyrolepis*. There seems slight doubt that this is the same form for which the generic name *Progyrolepis* was subsequently proposed in 1893. Aside from a reference by Woodward (1891, p. 501) to *Elonichthys speciosus*, this fish apparently has received little attention by later writers, although Romer (1945b, p. 579) accords it valid generic rank as a member of the restricted family Palaeoniscidae (Aldinger, 1937, p. 229).

Structurally the form may be briefly characterized as follows: medium-sized, fusiform fishes; skull broad and low with large forwardly situated orbit, and very oblique suspensorium. Frontal wider behind than forwardly. Supratemporal-intertemporal large, preceded in anterior sequence by a small dermosphenotic, and a much enlarged postorbital. Maxillary with short exposed infra-orbital portion; peculiar long, low, triangular postorbital expansion; and deeply produced posteroventral angle. Mandible without coronoid or angular processes. A pair of preoperculi present on either side. Branchiostegal rays are numerous, about 15 pairs. Median gular small, and the posteriorly succeeding single pair of lateral gulars only moderately enlarged. Dentition consisting of a more lingual series of large conical teeth irregularly interspaced with smaller ones. Bones of the head ornamented with pustulate tubercles and short irregular ridges of ganoine.

Scales small and only moderately thick; mostly rhomboidal; ranging from ones slightly

[1] Received October 31, 1946.

deeper than long to examples only one-third as high as long. All with a robust, internal, vertical rib. Peg-and-socket articulation developed only on some of the flank scales. Ornamented with coarse, diagonal ridges and grooves. Ganoine restricted to the crests of the ridges.

Fin rays closely articulated; each segment being ornamented with a few longitudinal ridges. Fulcra minute.

Genotype.—Progyrolepis speciosus Fritsch.

Progyrolepis tricessimalaris, n. sp.

Type.—M.C.Z. Cat. Fos. Fishes No. 6619; an obliquely crushed skull largely lacking the roofing, temporal, and opercular series of bones; also several associated fragments showing body scales, portions of two fins and several axial supports.

Geological horizon.—Admiral formation, Wichita Group of the Lower Permian.

Locality.—In Rattlesnake Canyon, 9 miles southeast of Dundee, Archer County, Tex.

Diagnosis.—An early Permian form that differs from the late Pennsylvanian European genotype in a more uniformly tuberculated ornamentation of the head bones; lack of basally ornamented teeth; and a proportionate enlargement of the grooves and somewhat more regular ridge pattern of the scale ornamentation.

Description.—The left lower jaw measures 4.9 cm in length. This dimension would seem to indicate a medium-sized fish possessing a total skull length of about 7 cm and a total body length not much exceeding 35 cm. The skull is proportionately long, low and moderately broad. From these points, it may prove permissible to assume that in general body proportions the fish was slenderly fusiform.

The endocranium is incomplete. Two pieces, however, which roughly include the anterior two-thirds of the neurocranial complex, are preserved. The retention of recognizable shape by these parts seems due to rather complete ossification. In texture, they are coarsely granular with a thin investiture of delicate perichondral bone. No sutures have been detected within these preserved portions of the braincase.

The anterior of the two endocranial parts is observable in dorsal view. Its left margin is covered by the displaced remnants, from the left side, of the frontal, the postorbital and fragmentary elements of the palatoquadrate complex. The right margin is entire and is traceable from a transverse plane in the hind portion of the orbit forward to an apparently complete anterior extremity. This extremity is presumably the tip of the sphenoidal ossification rather than the anterior limits of the ethmoidal calcification, since the part is uniformly narrow and is without the forward, laterally expanded structures which among other functions house the anterior myodome and enclose the olfactory organs. The dorsal surface is gently convex from side to side, and is completely covered with the thin lamella of perichondral bone. In consequence, it seems doubtful that the anterior fontanelle, normally large in the palaeoniscoids, was extended as far forward as the sphenoidal region. A low shelf extends transversely across the roof showing the position of the frontopostrostral suture. Two notches are shown on the right margin of the part. The more anterior of the two is situated near the anterolateral extremity of the postrostral bone. The posterior notch occupies the position of the anterolateral angle of the frontal. Both are assumed to have accommodated branches of the superior ophthalmic nerve to lateral line sensory organs of the supraorbital canal.

The posterior of the two preserved endocranial parts comprises the orbitotemporal region and is exposed in dorsolateral aspect from the left side. Recognizable structures on this part are the longitudinal, median dorsal, cranial vault which is crushed down into the lower and more laterally lying parts of this neurocranial region. These latter show with clarity the anterior reaches of the fossa bridgei, the posterodorsolateral wall of the orbit, and postorbital process, and the vertically disposed concavity posteriorly adjacent to the postorbital process into which the spiracular canal has its ventral opening, and against which the ascending wing of the parasphenoid articulates. A foramen pierces the observable part of the orbital wall. A similar foramen in *Pteronisculus* (=*Glaucolepis*) (White and Moy-Thomas, 1940) is thought by Nielson (1942) to convey a vein. A well-pronounced spiracular groove traverses the floor of the fossa bridgei forwardly and laterally from behind to enter the large spiracular canal. At the point of juncture between the spiracular canal and groove a distinct notch may be remarked, which very

probably transmitted the otic branch of the facial nerve. An extremely narrow and poorly defined area, devoid of the perichondral lamella, in the median dorsal line has been tentatively identified as the anterior fontanelle. It arises well back opposite the postorbital process and extends posteriorly for an undetermined distance. A median and backwardly projecting process of bone from its anterior margin appears to partially divide the vacuity. Whether this apparent posterior restriction of the anterior fontanelle has any taxonomic or phylogenetic significance, or is merely a case of more complete ossification, has yet to be determined. As thus incompletely revealed the endocranium of the present specimen offers no structures at wide divergent development from any of the few palaeoniscoid braincases yet known in detail. It seems to agree most closely to those of Palaeoniscid B from the Kansas Pennsylvanian described by Watson (1925), and of *Pteronisculus* from the Greenland Triassic studied by Nielson (1942).

Regarding the dermal bones investing the neurocranium, ventrally, the parasphenoid is not evident. The portion of a bone is displayed between the displaced anterior extremities of the mandibles but is too imperfectly exposed for other than tentative identification as the vomer. Dorsally, the posterior half of the left frontal alone is preserved of the roofing bones adjacent to the median line. The left margin of this element is hidden, but the bone is indicated to be of irregular shape, much wider behind than in its forward part, and to have articulated with its opposite member in a rather sinuous, overlapping, median suture. While partially impressed on the sphenoidal ossification the entire outline of the postrostral plate can not be determined. Dorsolaterally in the position of the temporal bones, the lateral edges and in narrow extent the external surfaces of three elements are exposed. The most posterior of these three is long and is termed the supratemporal-intertemporal. The middle element of the series is small, and in bearing a curved segment of the infraorbital sensory canal is called the dermosphenotic. The third and most anterior of the three bones is identified as the postorbital despite an inability to demonstrate the infraorbital canal. The posterior extremity of this latter element is wedged between the dermosphenotic dorsally, and the circumorbital series ventrally. It is extended notably far anteriorly, presumably paralleling the lateral edge of the frontal, to assume in greater or lesser degree the role of the supraorbital bones.

The orbit appears to have been rather large with its hind margin situated at the middle of the maxillary length. Only the most posterodorsal and next anteroventrally succeeding infraorbital bones are present. These are narrow and the former shows the infraorbital sensory canal. Although bony tissue remains in the position of the suborbitals, the number and shape of these components of the cheek can not be determined.

The gape of the mouth is wide and the suspensorium is very oblique. The maxillary is of the usual palaeoniscoid form but is remarkable in the great proportionate length and lowness of its vertically expanded postorbital portion, which is correspondingly triangular in outline rather than quadrangular. Its posteroventral angle is produced downward to overlap widely the proximal end of the mandible. It seems probable that the maxillaries articulated with each other anteriorly although this can not actually be observed. The forward portions of

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FIG. 1.—*Progyrolepis tricessimalaris*, n. sp. (M.C.Z. Cat. Fos. Fish No. 6619). Photographs of the fragmentary skull in (A) dorsolateral aspect from the left side and in (B) inferior view with (C and D, respectively) corresponding explanatory sketches. Approx. $\times\frac{3}{4}$.

a.hy, Groove for afferent hyoid artery; *Ang*, angular; *Art*, articular; *ba*, branchial arch elements; *Chy*, ceratohyal; *Cla*, clavicle; *D*, dentary; *Dp?*, dermopalatine; *Dsph*, dermosphenotic; *f*, fulcra; *fa*, anterior fontanelle; *fb*, fossa bridgei; *Fr*, frontal; *gp*, gular pit line; *Inf*, infraorbital; *lep*, lepidotrichia; *Lg*, lateral gular; *m. cp*, notch for posterior portion of coraco-arcualis muscle; *Md*, mandible; *Mg* median gular; *Mk*, Meckelian ossification; *Mx*, maxillary; *Ot*, orbitotemporal portion of neurocranium; *Pop. 1*, dorsal preoperculum; *Pop. 2*, ventral preoperculum; *p. po*, postorbital process; *pq*, remnants of palatoquadrate ossifications; *Pto*, postorbital; *Rbr*, branchiostegal rays; *ro*, notch for otic branch of facial nerve; *S?*, suborbitals; *s*, scales; *Sang*, surangular; *sci.*, infraorbital sensory canal; *sc.p*, preopercular sensory canal; *sc.s*, supraorbital sensory canal; *so*, notches for branches of the superior ophthalmic nerve to lateral line sensory organs in supraorbital canal; *Sph*, sphenoidal portion of the neurocranium; *spic*, spiracular groove and canal; *St-it*, supratemporal-intertemporal; *V?*, vomer; and *v*, foramen for vein.

both palatoquadrates are preserved but have been badly weathered. The remnants appear to be composed of lamellar bone but no sutures have been definitely established. On the right side, a slender dentigerous fragment occurs which may pertain to a dermopalatine ossification.

The mandible is large. It is low and slender anteriorly but progressively increases to a maximum depth posteriorly. The dorsal mar-

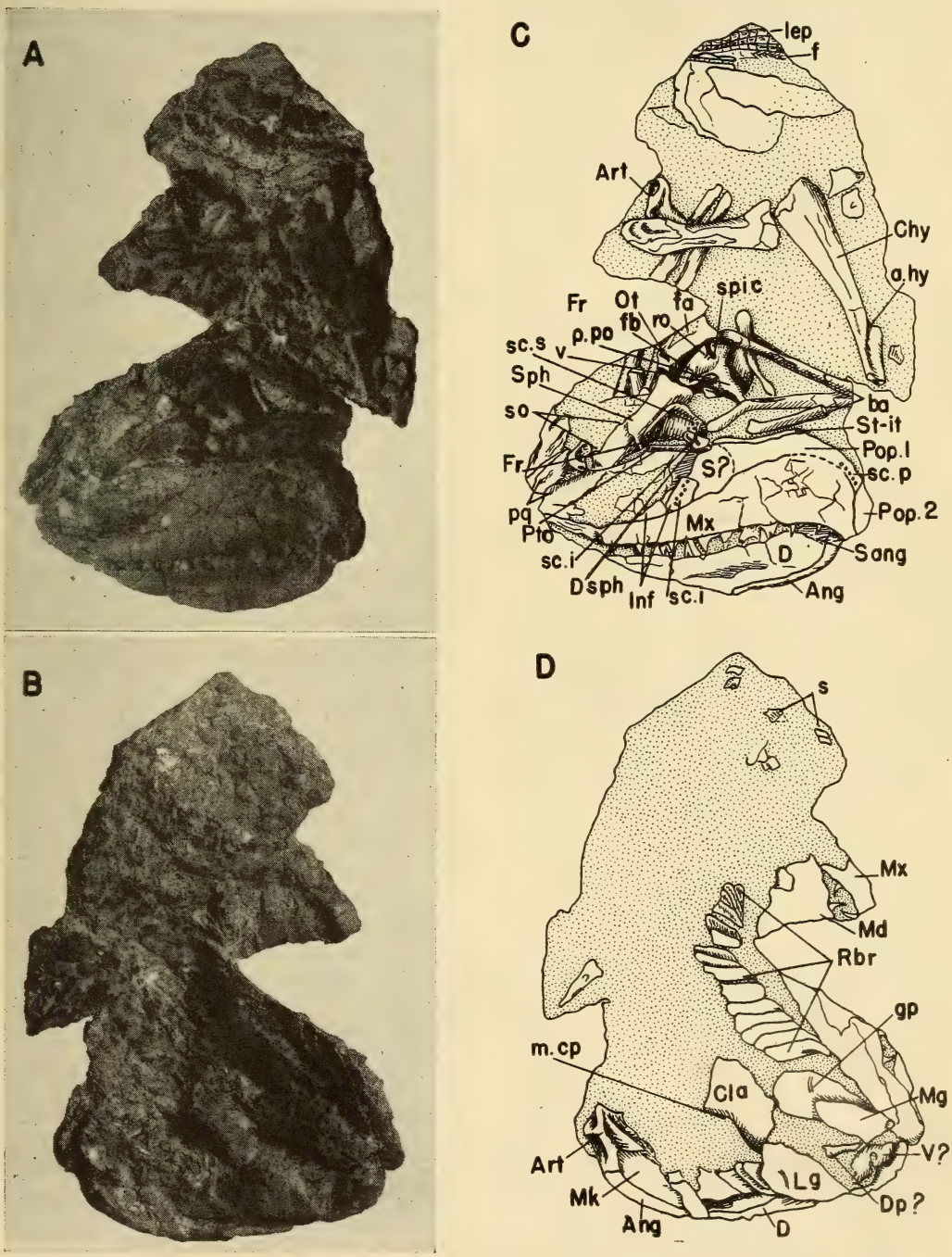


FIG. 1.—(See opposite page for legend.)

gin maintains a constant gentle concave profile throughout the total observable length of the complex and shows no evidence of a coronoid development. The Meckelian cartilage is well ossified posteriorly where exposed. The articular is high and robust. The quadrate articulates with it dorsally and a well defined vertical groove occupies its broad posterior margin. The determinable dermal bones of the mandible consist of the usual large dentary, a narrow, posteroventral angular which shows no appreciable dorsal expansion on either the external or internal faces of the lower jaw, and a short, moderately high supra-angular.

The maxillary and lower jaws are provided with both large and small series of teeth. As preserved, these have been badly eroded but appear to exhibit an irregular arrangement although the large ones generally are more lingually placed than some of the small ones. All are sharply conical, somewhat incurved, with "enamel" caps in their distal thirds, and without evidences of vertical striations or other ornamentation on their bases.

Of the bones associated with the hyoid arch only the ceratohyal, the preoperculum, the gulars and the branchiostegal rays are contained in the recovered fragments. The ceratohyal is a large element, considerably flattened during preservation. It appears composed of cancellous bone with a thick investment of dense lamellar tissue. It is deepest behind and tapers forward with no marked anterior deepening. A groove for the afferent hyoid artery traverses the edge of the element as exposed. The preoperculum is represented by two elements on either side. The large dorsal one of these is of characteristic form and while very obliquely inclined, the angle between the rather broad posteroventral, vertical shank and the slightly expanded anterodorsal portion is noticeably obtuse. The second preoperculum is small, somewhat deeper than long and appears to be firmly attached to the posteroventral extremity of the dorsal member. The median gular plate is relatively small and considerably wider anteriorly than posteriorly. It is flanked posterolaterally by a single pair of moderately enlarged gulars. The radii branchiostegi number a possible 15 on each side. They decrease in both length and width from front to back. The anterolateral angles of each seem to be produced in greater or lesser degree. The area of overlap on the first by the lateral gular is almost a third as wide as the exposed ornamented portion of the ray laterally, but is extremely narrow mesially.

Remnants of the branchial arches are displayed. None, however, are complete and it is impossible to interpret them in relation to each other or to the visceral skeleton as a whole. The elements consist of long, thin, rod-like structures which in some cases are apparently hollow with walls made up of concentric layers of dense bone. Generally, the bars are thicker proximally and all are longitudinally grooved, posteriorly.

Only small segments of the lateral line sensory canals have been detected. These are indicated on the accompanying drawings and call for no further discussion.

The dermal bones of the head possess an apparently complete layer of ganoine. This is raised into fine and closely set tubercles which are apically tumid even in the best preserved examples. Each has an internal pulp cavity and externally bears a few, comparatively coarse radial striae. On the frontal these tubercles, while not losing their identity, are aligned in short irregular ridge series. This partial fusion also occurs on the maxillary in a zone adjacent to and paralleling the orbital and more posterior dorsal margin; on the dorsal preoperculum parallel to the anterior edge of the ventral shank; on the mandible next to its oral margin; and completely covers in irregular arrangement the gular plates and branchiostegal rays.

In one of the unassociated fragments of matrix there is contained a number of attenuated rods of cancellous tissue rimmed with dense bone. In form, these structures appear similar to the "rifle-shaped" axial supports which Stensiö (1921, p. 189) termed the basidorsal elements of the vertebral column of *Birgeria*.

Little can be said regarding either the appendicular girdles or the paired and unpaired fins. The right clavicle is incompletely preserved and can be seen in external aspect. It is convex in transverse section and the dorsolateral margin is strongly notched for the insertion of the posterior division of the posterior coraco-arcualis muscle. The surface is ornamented with the typical pustulate tubercles which are sometimes irregularly arranged in

short ridges. The two fin remnants can not be identified. The rays composing each are similar: closely articulated; and ornamented with by no more than four coarse longitudinal ridges of ganoine. Of this ornamentation of the lepidotrichia, it may be further stated that the posterior three ridges are strong while the anterior one is usually less pronounced; trends obliquely toward the anterodistal angle of each segment, or may even be obsolete. The paired fulcral scales are minute.

The specimen shows quantities of well-preserved scales. Unfortunately all are scattered, and it has not been possible to determine from what body part any particular example was derived. Generally, however, the scales may be considered as small, averaging only 3.0 mm in length. A few are oddly sigmoidal in form, but

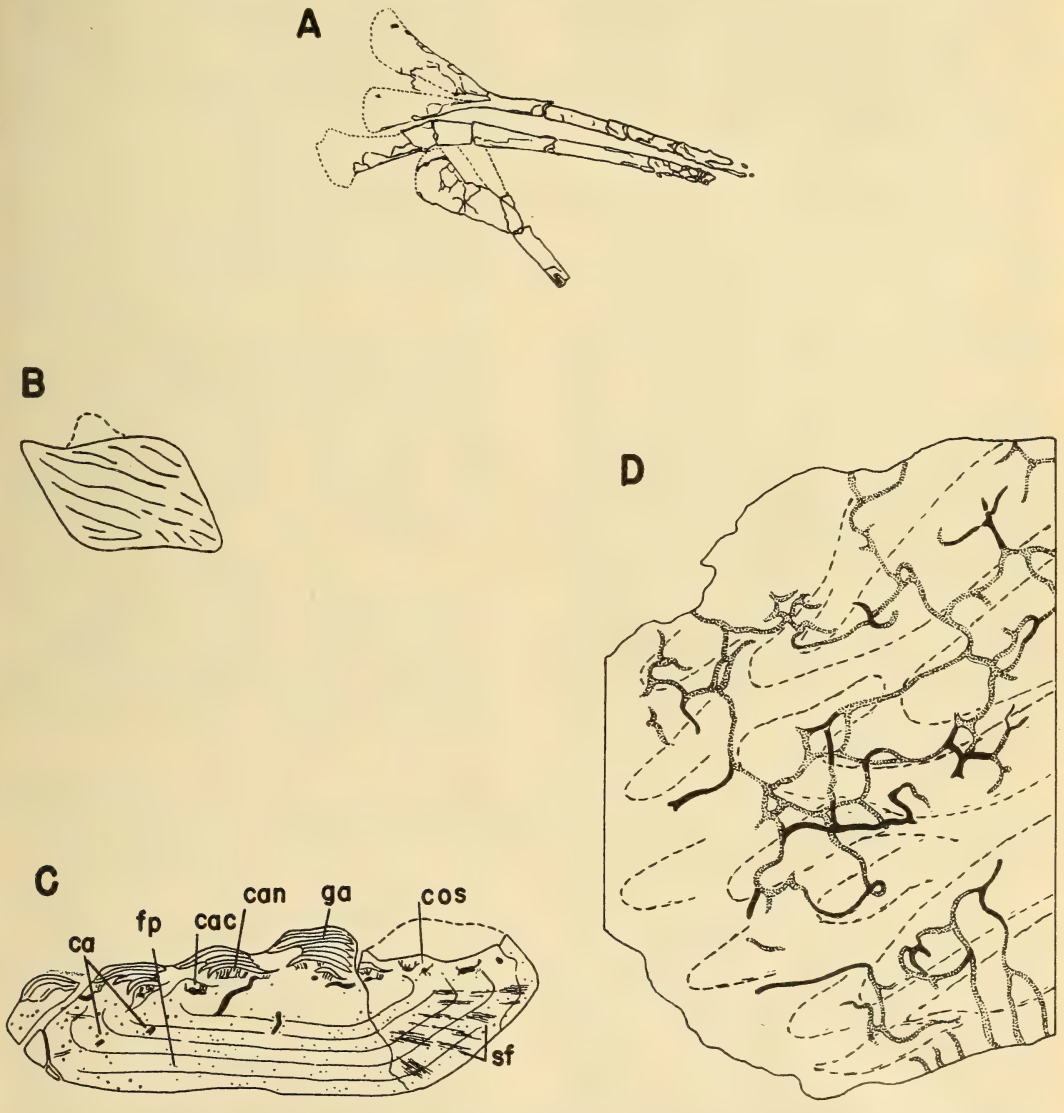


FIG. 2.—*Progyrolepis tricessimalaris*, n. sp. (M.C.Z. Cat. Fos. Fish No. 6619). A, Axial supports, Approx. ×2. B, Outline of flank scale with lines indicating the crests of ornamental ganoine ridges. Approx. ×8. C, Transverse section through scale. Approx. ×30. D, Horizontal section through scale showing arrangement of canals in cosmine layer and dashed lines indicating the pattern of external ganoine ridges. Approx. ×23.

ca, Vertical canals traversing bony footplate; *cac*, horizontal canals in cosmine layer; *can*, canaliculi: *cos*, cosmine layer; *fp*, laminated bony footplate; *ga*, ganoine; and *sf*, Sharpey's fibers.

by far the majority are rhomboidal. None are much deeper than long, and commonly the height is one-half to one-third the length. All show a moderately produced anterodorsal angle; a nondenticulate posterior margin; almost uniform thinness; and a strong internal vertical rib which is in no case sharply delimited from the surface of the scale. Peg-and-socket articulations have been observed only on the scales which are as high as long. On these latter, also, the anterior area overlapped by the preceding scale equals one-fourth the length of the scale. On those which are longer than high, the covered area amounts to one-fifth or less the length of the scale.

The ornamentation on the scales is strong. Differences in the sculpture on scales from various body regions can not be shown as great, and the variations manifest seem to be chiefly minor modifications of one basic pattern. The markings consist of striations. These are generally coarse, sharp-edged with broad concave grooves between, and traverse only slightly sinuous courses across the face of the scale. On the larger, more equilateral scales two to three ridges arise across the dorsal margin, and five to eight along the anterior edge, just behind the overlapped area. The former are short, usually entire, and extend downward and backward in a somewhat steeper angle than do the latter, longer striae. The first long ridge originates in line with the anterodorsal angle of the scale and is directed back toward the middle height of the posterior margin. The long ridges on the large scales cover only the anterior two-thirds of the external surface area. The more dorsal ones, on a few examples, are seen to bifurcate anteriorly. Ventrally, two long ridges frequently anastomose posteriorly, and sometimes a tubercle is present between the divided anterior ends of the two. On the posteroventral third of the external area the ridges break down into elongate tubercles, which, while occasionally of irregular disposition, are usually aligned along the same linear axis of the anteriorly preceding ridge. On the scales which are generally longer than high, there is to be observed neither a decrease in size nor a change in the disposition of the ridges and interspaced grooves. The differences in ornamentation between the high and low scales consists merely of a reduction, commensurate with the external area, in the number of these markings. Those scales having the least height may entirely lack the striae arising along the dorsal margin, and the ridges originating along the anterior margin may be decreased in number to as few as two. Here, also, the long striae are not always broken down posteriorly into tubercles, but may extend to the posterior edge of the scale.

Attempts to section the scales were generally unsatisfactory because of the fractured condition of the structures. The bone, cosmine and ganoine layers, however, were observed in several hand-ground preparations. The bony footplate consists of relatively few successive lamelli. Ascending canals are enclosed within this layer posteriorly and centrally, and evidences of the dense bundles of Sharpey's fibers were encountered in all sections. The cosmine layer is apparently very thin, and is indicated to have been disposed in isolated bands posteriorly, although the arrangement of these bands could not be determined. Bone cell spaces are irregularly distributed throughout this and the preceding layer except immediately around the canals, where they appear concentrically arranged. The canal plexus of the cosmine layer is an anastomosing network of irregular radial and longitudinal tubes. The canals lay at different levels. The canalicular system appears densely developed in the longitudinal sections but only sparsely evidenced in the transverse ones. The ganoine is restricted to the ridges of the striations. No ascending canals were found penetrating either the ganoine or the dentine floor of the interspaced grooves.

Remarks.—In determining the currently described fish, a number of Permo-Carboniferous genera were arbitrarily omitted from consideration. These include *Geomichthys*, *Gyrolepidotus*, and *Trachelacanthus*. All are incompletely known fish types for which adequate references are not available to this writer.

Of other genera, this Texas species has been shown to be remarkably similar to the European *Progyrolepis speciosus* in size; the structure of the frontal, maxillary, and mandible; the dentition; and squamation. In fact, the differences between the two species, consisting mainly of variations in the ornamentation of the head bones and scales, are minor. It seems probable, however, that differences of greater magnitude will become apparent when more complete specimens of both are found.

Based on fragmentary material, *Progyrolepis* can be only incompletely defined at this time. In consequence, certain doubts as to the exclusiveness of its definition and to the relationships of the form probably must be still entertained. The genus bears strong resemblances to the elonichthyids, the palaeoniscids, and the pygopteryids. These three families apparently represent the, as yet, quite tentative grouping of a number of closely allied genera whose interrelationships have not been entirely worked out. The combination of morphological features outlined in the foregoing generic characterization is suggestive of an interesting early attainment of the structural condition of the Triassic paleoniscid *Pteronisculus*, and has prompted the present interpretation of structure in support of the recent assignment of *Progyrolepis* to the restricted family Palaeoniscidae (Romer, 1945b).

In conclusion, while certain enticing paleogeographical questions are presented by the occurrence of presumably the same genus almost contemporaneously in both the eastern and western hemispheres, speculation on the points seems useless until the genus is more adequately understood.

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ICHTHYOLOGY.—Gila cypha, *a remarkable new species of cyprinid fish from the Colorado River in Grand Canyon, Arizona.*[1]

ROBERT R. MILLER, U. S. National Museum.

The fish fauna of the vast Colorado River Basin of western North America is the least well known of the major drainages of the West. Our knowledge of the ichthyology of this river began with the surveys during the middle of the last century by Captain Sitgreaves, the Pacific Railroad Surveys, and by the United States and Mexican Boundary Survey. Since that time, however, only one of its major tributaries, the Gila River of southern Arizona, has been moderately well explored throughout for fishes, and even in that comparatively small watershed the job is incomplete. The greater portion of the Colorado remains virtually untouched.

In the narrow and barren inner gorge of the Grand Canyon, the Colorado River is a swift, silt-laden stream, subject to intense floods. It thus provides a habitat that fishes of usual body form can not resist, and a type of environment that has remained unexplored by collectors. While I was exam-

[1] Published by permission of the Secretary of the Smithsonian Institution. Received November 8, 1946.

ining the fish collection at Grand Canyon National Park in the fall of 1942, a single specimen obtained from this part of the Colorado River caught my attention. Subsequent study has shown it to be of unusual interest in possessing remarkable adaptations for life in torrential waters, and the specimen is now the holotype of the novelty described below.

No fewer than 12 nominal species referrable to the genus *Gila* have been attributed to the Colorado River fauna (Jordan, Evermann, and Clark, 1930, pp. 114, 119). Information now at hand indicates that no more than two species, *Gila robusta* and the novelty recognized herein, are known to inhabit the basin. None of the described forms has attained the extremes of specialization and the bizarre appearance of this new species.

Genus **Gila** Baird and Girard

Gila cypha, n. sp.

Fig. 1

Diagnosis.—A strongly compressed *Gila* with the sides of the body slightly convex and with a prominent abrupt hump over the occiput; body almost entirely devoid of scales (except for about 80 in lateral line) which have basal radii; fins expansive, falcate; snout fleshy; mouth inferior; eye very small.

Holotype.—The holotype (U.S.N.M. no. 131839) is a specimen about 305 mm in standard length and was taken by N. N. Dodge near Phantom Ranch in the western end of Grand Canyon National Park, Arizona. It was caught in swift water on hook and line, presumably in the nearby Colorado River at or near the mouth of Bright Angel Creek.

Nontypes.—A specimen (U.S.N.M. no 20083) in fair condition, but lacking data, is referred to the new species, and it is very reasonable to assume that it came from the Colorado River drainage, for cyprinid fishes of this type are known only from that basin. It is compared with the holotype in Table 1. Another specimen (U.S.N.M. no. 15349), represented only by the head, nape, and pectoral fins, and likewise without locality data, also is referred to the new species, for it bears the prominent, abrupt hump which is believed to characterize *G. cypha.*

Description.—The form and coloration of *Gila cypha* are portrayed in Fig. 1, and the proportional measurements are given in Table 1. The following description is of the holotype. Fin rays: Dorsal iii, 9, the first full-length ray unbranched and preceded by 3 graduated, rudimentary rays, the first one very small; anal iii, 11, the first full-length ray unbranched and preceded by 3 graduated, rudimentary rays; pectoral rays 18 in each fin; pelvic rays 9 in each fin; principal caudal rays 20, 18 branched plus a full-length unbranched ray above and below.

Scales in lateral line about 80, embedded and only slightly imbricated anteriorly and becoming more embedded and less imbricated posteriorly until those on the caudal peduncle are scarcely evident (drawn too clearly in Fig. 1). Scales above the lateral line deeply embedded and, for the most part, completely isolated from one another, not evident above the level of the base of the nuchal hump. Scales below the lateral line similar to those above, not evident below the base of the pectoral fin except in the region behind the pectoral fin. Back, breast, and belly completely devoid of scales. Dorsal and ventral surfaces of caudal peduncle completely smooth and scaleless, about three or four irregular rows of embedded scales above and below the lateral line anteriorly which taper off to only one or two such rows above and below the lateral line posteriorly. In degeneration of squamation, *Gila cypha* is closely approached by *Gila robusta elegans* Baird and Girard and, to a lesser extent, by *Gila robusta seminuda* Cope and Yarrow (herein tentatively recognized); the new species is exceeded in this feature by two unrelated genera of cyprinids, *Plagopterus* Cope and *Meda* Girard, in which scales are usually completely lacking. Other Colorado River fishes, such as the cyprinids *Ptychocheilus lucius* Girard and *Tiaroga cobitis* Girard, and the catostomid *Xyrauchen texanus* Abbott, also have lost some of their scales. This desquamation appears to have taken place in response to adaptation to a swift-water habitat, making the body surfaces smoother and thereby reducing friction. Most of these fishes also have well-streamlined bodies.

Total gill rakers nine on the left side, 11 on the right, short and dimorphic; those (two or three) on the upper limb and the one at the angle of the arch are slender, pointed, and

curved at the tip, whereas those on the lower limb are shorter and thicker and all but the most anterior ones are variously forked. All the rakers are attached anteriorly to the gill arch by a broad membrane. Pseudobranchiae weakly developed.

Dental formula 2, 5–4, 1?, three teeth (1 in main row, 2 in lesser row) missing on the left arch and one tooth (in main row) missing from the right arch, with the definite possibility that there is also one tooth missing from the lesser row of this arch (if so, the formula would be 2,5–4,2 as usual in *Gila*). The teeth in the main row are thick, especially toward the base, bluntly pointed, with a weak grinding surface on the first two. No doubt the teeth were modified during the lifetime of the fish, as is characteristic in cyprinid fishes. The only tooth remaining on the lesser row (right arch) is well developed, conical, and bluntly pointed.

The pharyngeal arches are unusually small for a fish the size of the holotype (approximately 305 mm, standard length). The total length of each arch, measured from the apex of the upper limb to the tip of the lower limb, is only 21.8 mm (left arch) and 22.7 mm (right arch). The total lengths of the arches of the largest cotype of *Gila robusta* Baird and Girard (=*G. r. robusta*, U.S.N.M. no. 246,[2] approximately 305 mm long) are 31.8 (left arch) and 32.6 (right arch)—10 mm. longer than the specimen of *Gila cypha* of the same length. In *cypha* the upper and lower limbs of each arch (measured from the base of the first and last teeth of the main row) are almost exactly equal, whereas in the cotype of *robusta* the lower limb of each arch is slightly longer. Both the upper and lower limbs are thicker in *cypha* than in the cotype of *robusta*. In U.S.N.M. no. 20083, tentatively referred to *cypha* (see discussion under Nontypes and Table 1), the total length of each arch is likewise short: 21.7 (left) and 21.2 (right), with the standard length of the specimen approximately 315 mm. Unfortunately, the pharyngeals of the only other specimen referred to the new species (a head, U.S.N.M. no. 15349, see under Nontypes) are missing.

In size and shape, the pharyngeals of the new species much more closely approach those of *G. robusta elegans*. In the type of *elegans* (U.S.N.M. nos. 251 and 20079,[3] a fish about 245 mm long) the total length of the left arch is 20.5 mm or about one-twelfth the standard length, as compared with about one-fourteenth this distance in the holotype of *cypha*. As in the new species, the two limbs of the arch are equal. The main difference between the left arch of *elegans* and that of *cypha* lies in the greater curvature of the upper limb and particularly the more compressed form of the lower limb in *elegans*. Thus the least width of the lower limb divided into the total length of the arch gave ratios of 1.5 (type) and 1.4 (U.S.N.M. no. 45404, see Table 1) in *elegans* as compared with ratios of 0.9 (holotype) and 1.2 (U.S.N.M. no. 20083) in *cypha*.

In coloration the holotype of *Gila cypha* (originally preserved in formalin, in which it remained for some time) is brownish—pinkish brown on the sides and belly and yellowish brown along the back. On close examination, most of the head, back, and sides above the level of the lateral line are densely covered with dark puncticulations; these extend below the lateral line in the region above and behind the pectoral base and near the base of the caudal fin. The same pigmentation occurs near the base of the first pectoral ray (left fin particularly), and also near the bases of the interradial membranes of the dorsal and caudal fins.

The following measurements were stepped off with a pair of precision dividers under a magnification of about 2½ times. Body depth in standard length, 4.25; head length in standard length, 4.1; head depth in head length, 1.5; head width in head length, 1.7; length of caudal peduncle about 3.3 in standard length; least depth of caudal peduncle in head length, 4.8, in base of dorsal, 2.8; length of snout in head length, about 2.7; eye in head, about 13.0, in least depth of caudal peduncle, about 3.0; dorsal and anal bases equal, 1.6 in head; length of pectoral almost equal to that of

[2] JORDAN and EVERMANN, 1896, p. 227, erred in giving the type the numbers 276, and 277 (which are codfish, according to the National Museum register).

[3] Reentered by error as U.S.N.M. no. 20079. Jordan and Evermann, 1896, p. 227, wrongly cited nos. 935 and 20265 as the type, Major Thomas as collector, and included the Colorado and Gila Rivers in the type locality. The single specimen was collected by Dr. Woodhouse in the Zuni River, N. Mex., a tributary of the Little Colorado River.

head; length of pelvic 1.4 in head length; length of longer (upper) caudal lobe much greater than head length and about 3.3 in standard length.

The only other entire specimen believed to represent *Gila cypha* (U.S.N.M. no. 20083, Table 1) differs principally from the holotype of *cypha* in having a deeper body (greatest depth about 3.7 rather than 4.25 in standard length), a larger eye (10.6 in head and 2.5 in least depth of caudal peduncle, rather than 13.0 and 3.0), and a somewhat greater extent and better development of squamation. The scales above the lateral line are particularly less degenerate in this specimen than in the holotype, though they are embedded and are posteriorly isolated from each other (as nearly everywhere in the type). They are developed up to about a level with the middle (rather than the base) of the nuchal hump. Below the lateral line the scales are only very slightly better developed than in the holotype As in that specimen, the back, breast, and belly are devoid of scales except for a few exceedingly minute and deeply embedded ones scattered at random over the back, particularly anteriorly. The dorsal and ventral parts of the caudal peduncle are also smooth and lack scales, except for a few minute remnants. There are about six or seven (rather than three or four) irregular rows of embedded scales anteriorly above and below the lateral line along the caudal peduncle which taper off to three or four (rather than one or two) nearly indistinguishable rows posteriorly. The other differences in measurements (Table 1) between this specimen and the holotype of *cypha* lie within the expected range of intraspecific variation.

Comparisons.—*Gila cypha* obviously belongs to the subgenus *Gila*, as recently tentatively defined (Miller, 1945, p. 104), even though its small scales, which lack a basal shield, have basal radii in addition to apical and lateral radii; the teeth are 2,5–4,2 (in U.S.N.M. no. 20083; perhaps only 2,5–4,1 in holotype), and the dorsal origin is behind the insertion of the pelvic fins. The only other species of this subgenus which I now recognize from the Colorado drainage is *G. robusta* Baird and Girard. In the paper cited above, I listed *Gila elegans* Baird and Girard separately, with the suggestion (long ago advocated by Dr. Carl L. Hubbs) that it probably represents an ecological subspecies of *robusta*. I am convinced that *robusta* and *elegans* are only subspecifically separable, for the five types of *Gila seminuda* Cope and Yarrow (U.S.N.M. no. 16975) seem to close the gap between those nominal species (Table 2). It is therefore necessary to compare *cypha* only with *robusta*, *minacae* Meek, and *nigrescens* (Girard), the other species of the subgenus *Gila*.

The new species differ sharply from those three species and from all of the subspecies of *robusta* (as tentatively diagnosed in Table 2), except *r. elegans*, in having very degenerate squamation, expansive falcate fins, a dorsoventrally flattened head, an inferior mouth and a long fleshy snout. In these features *cypha* is closely approached by *G. r. elegans*,

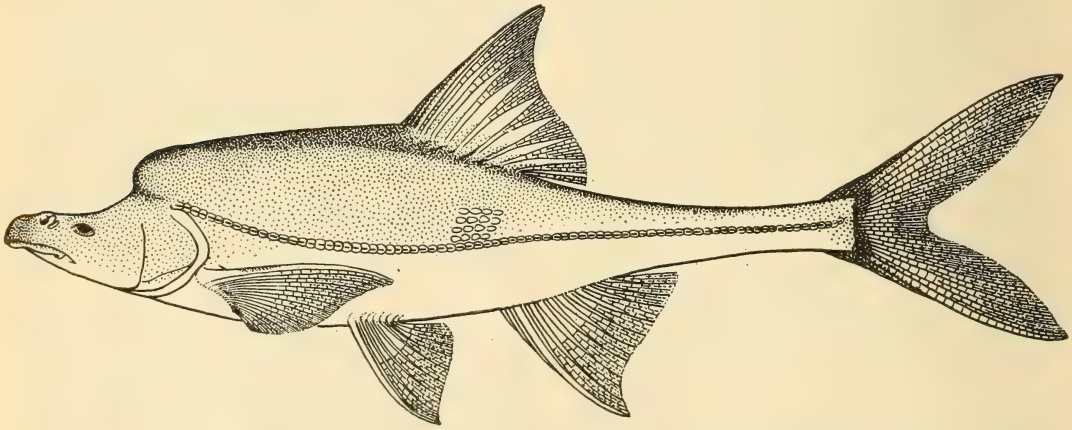


FIG. 1.—*Gila cypha*, n. sp.: Holotype (U.S.N.M. no. 131839), 305 mm in standard length. Drawn by Mrs. A. M. Awl.

the swift-river representative of the *robusta* series commonly called "bony-tail" because of the hard, pencil-shaped caudal peduncle. The most conspicuous difference between *cypha* and *r. elegans* is the prominent nuchal hump for, although I have examined 80 specimens of *elegans* from the lower Colorado River (Grand Canyon to Baja California), representing yearling to very large adults (up to 385 mm standard length), none of these has shown more than a broad, even convexity in the nuchal region. The degeneration and disappearance of the scales is far more advanced in *cypha* than in typical *elegans* for in the "bony-tail" only the back, breast, belly, and upper and lower surfaces of the caudal peduncle may be naked, whereas most of the body and nearly the entire peduncle are naked in the holotype of *cypha*. The scales of *G. r. elegans* also seem to lack basal radii, for in 26 specimens examined for this character I found only apical and lateral radii developed. The scales examined were taken from the region just above or below the lateral line, directly above the base of the pelvic fins, preferably on the right side of the body.

Comparative measurements between *cypha* and *G. r. elegans*, given in Table 1, indicate strong to slight differences in certain features. The reliability of these data, however, is lessened by the few specimens involved and perhaps also by the possibility of sex-correlated characters. The deeper but narrower body and head, slightly longer snout, smaller eye, and greater distance between the origin of the anal fin and the base of the caudal fin in *cypha* are characters which probably do not show sex dimorphism. The greater size of all of the fins in this species, however, as compared with *elegans*, might be solely an expression of maleness. On the other hand, the more expansive fins may be the result of adaptation to swift water, thus providing the species with stronger appendages for resisting the current. It is indeed unfortunate that the body cavities of the two specimens of *G. cypha* are eviscerated,

TABLE 1.—PROPORTIONAL MEASUREMENTS OF GILA CYPHA AND GILA ROBUSTA ELEGANS

Character	*Gila cypha*		*Gila robusta elegans*[1]		
	Holotype	U.S.N.M. 20083	U.S.N.M. 45404	U.S.N.M. 936	U.S.N.M. 76386
Standard length, mm	305±	315±	318±	325±	338±
Measurements in thousandths of the standard length:					
Dorsal origin to tip of snout	479	487	465	485	484
Pelvic origin to tip of snout	409	429	409	405	426
Anal origin to caudal base	441	422	419	408	424
Body, greatest depth	239	276?	222	199	185
Greatest width	117	131?	154?	150	140±
Head, length	237	237	243	228	239
Depth	160	169	131	114	129
Width	127	129	151	143	151
Caudal peduncle, length	298	276	259	289	294
Least depth	50	51	44	37	37
Interorbital, least bony width	83	85	89	85	84
Opercle, greatest length	74	70±	73	72	73
Snout, length	85?	89	79	73	81
Eye, length	19	24?	29	25	25
Orbit, length	26±	31?	33	31	32?
Mouth, width	89?	101?	92?	85	95?
Upper jaw, length	89	102	86	78	86
Mandible, length	87	89	90	83	89
Dorsal fin, depressed length	225	220?	214	204	201
Basal length	145	151	141	138	134
Anal fin, depressed length	221	211	186	181	187
Basal length	144	149	146	125	134
Middle caudal rays, length	87	90?	93	80	—
Upper caudal lobe, length	305±	—	247?	226	—
Pectoral, length	225	219	201	192	198
Pelvic, length	176	183	157	150	148
Sex	?[2]	?[2]	♀?	♀	♀

[1] Material from the lower Colorado River at and near Yuma, Ariz.
[2] Eviscerated.

making positive sex determination impossible.

The *Gila robusta* complex provides a fine example of correlation between ecology and morphology (Table 2). This remarkable correlation can only receive passing notice at this time for the problem has not been studied in detail and much more material, especially from the main Colorado, is needed. The small tributary and brook subspecies, *intermedia*, has a chubby body with comparatively large scales, small and rounded fins, and a comparatively deep caudal peduncle. The large tributary and smaller river form, *robusta*, has a more streamlined body with smaller scales, larger and slightly falcate fins, and a more slender caudal peduncle. The swift river-channel subspecies, *elegans*, is extremely well streamlined, with embedded scales (often absent on back and elsewhere) forming little resistance to the current, expansive and strongly falcate fins (caudal fulcra excessively developed), and a terete, pencil-shaped caudal peduncle.

The apparent end form of this series seems to be represented by the highly specialized *Gila cypha*, which, on the basis of the inadequate material at hand, cannot be aligned as a subspecies of *robusta*. If the trend in characters from *intermedia* to *elegans* shown in Table 2 continued beyond the *elegans* level, the next form would be expected to have at least 11 dorsal rays and a narrower caudal peduncle than *elegans*. The two specimens of *G. cypha* have, unexpectedly, only nine dorsal rays, and the caudal peduncle is deeper than it is in *elegans* (Tables 1 and 2). Moreover, the scales of the new species bear basal radii whereas those of *elegans* have only apical and lateral radii. In this character, *cypha* agrees with the otherwise very different looking *G. r. intermedia*. Both *G. cypha* and *G. r. elegans* occur in the main Colorado River although the precise ecologic niche for each form has not been determined. The scanty available data indicates that *elegans* collects at the mouths of the clear

TABLE 2.—PROVISIONAL COMPARISON BETWEEN SUBSPECIES OF GILA ROBUSTA AND GILA CYPHA[1]

Character	Subspecies of *G. robusta*				*G. cypha* (2 specimens)
	intermedia[2]	*robusta*[2]	*seminuda*[3]	*elegans*[4]	
Dorsal rays	8 (rarely 7 or 9)	9 (rarely 8 or 10)	9 or 10	10 or 11	9
Anal rays	8 (7–9)	9 (rarely 7, 8 or 10)	9 or 10	10 or 11	10 or 11
Pelvic rays	8–8 (frequently 9–9)	9–9 (rarely 10–10)	9–9 or 10–10	9–9 (rarely 10–10)	9–9
Scales	Fully scaled; 65–87 in lateral line; basal radii usually present	Fully scaled; 79–96 in lateral line; basal radii infrequent (rarely well developed)	Back, breast and belly naked in some; 77–89 in lateral line; 2 out of 5 with very faint basal radii	Back, breast, belly and much of caudal peduncle often naked or with minute, deeply-embedded scales; 75–88 in lateral line; no basal radii	Most of body naked; 77–80 in lateral line; basal radii moderately to well-developed
Nuchal hump	Absent	Slightly arched in very large fish[5]	Absent in material examined[3]	Moderate to high but evenly arched in larger specimens	Prominent, truncate anteriorly
Least depth of caudal peduncle into head length	2.6–3.4	3.3–4.3	4.1–5.2	5.0–6.5	4.6–4.7

[1] The counts and measurements recorded here for the subspecies of *robusta* have been jotted down over a period of five years during routine identification and examination of collections from the Colorado River drainage.

[2] Material from the Gila River Basin only.

[3] Based on the five types, 90 to 128 mm in standard length, U.S.N.M. no. 16975, which may be regarded either as intergrades between *robusta* and *elegans* or as an intermediate subspecies (as tentatively done above, as also by Ellis, 1914, p. 57).

[4] Material from the Middle and Lower Colorado only (Little Colorado to mouth of Colorado).

[5] Exaggerated in the drawing of one of the types of *G. robusta* (U.S.N.M. no. 246, largest fish) shown in Sitgreaves (1853, pl. 1, fishes).

tributaries and it has been taken some distance up the larger tributaries.

Habitat and associates.—Some conception of the rate of flow of the swift, silty Colorado River can be gained by records of the gauging station approximately 240 miles below Grand Canyon. Over the period 1917 to 1926, this rate varied between 1,800 and 174,000 cubic feet per second, with a variation between low and high water stages of about 25 feet (Thompson, 1929, p. 733). Dangerous rapids are interspersed throughout the Colorado River, especially in the Grand Canyon region, and have proved treacherous, and often disastrous, barriers to explorers of the river. Because of the scouring action of the river no vegetation can exist.

Judged from its large, falcate fins, specialized nuchal hump, inferior mouth, and dorsoventrally flattened head, *Gila cypha* is well adapted for life in the swift current very near or on the bottom. The action of the current against the prominent nape tends to force the fish down toward the bottom or the sides, where the flow is not so torrential as in midwater. The small eye may represent a degeneration correlated with reduced light due to the excessive silt, or it may be a response to the direct effect of the scouring action of the suspended matter, or both.

No scientific survey of the fishes of Grand Canyon National Park has been undertaken, but fish have been caught occasionally by angling and these few specimens (deposited in the Park collection) give an idea of the associates of *Gila cypha*. Among them are the humpback sucker, *Xyrauchen texanus* (Abbott), the mountain sucker, *Pantosteus delphinus* (Cope), *Gila robusta elegans* Baird and Girard, and the introduced channel catfish, *Ictalurus lacustris punctatus* (Rafinesque). Two others are to be expected in the main river as both occur elsewhere in the Colorado and are adapted for channel life: the flannelmouth sucker, *Catostomus latipinnis* Baird and Girard, and the Colorado squawfish or "salmon," *Ptychocheilus lucius* Girard, reputed to be the largest cyprinid fish in the New World (Jordan and Evermann, 1896, p. 225).

Range.—*Gila cypha* is known definitely only from the Grand Canyon near the mouth of Bright Angel Creek. The only other specimens referred to the new species are without locality data. The species may be found to be common in the main channel of the Colorado in Grand Canyon when that swift-water habitat is thoroughly collected. It may not occur below Boulder Dam, for I have seen a number of collections from that area and all the *Gila* therein are referable to *G. r. elegans*.

Etymology.—The specific name *cypha*, suggested by Dr. Carl L. Hubbs, is from the Greek κυφή, meaning hump-backed, in reference to the striking nuchal hump.

Acknowledgments.—It is a pleasure to thank the authorities of Grand Canyon National Park, and particularly Park Naturalist Louis Schellbach, for allowing me to describe this novelty and for donating the holotype to the U. S. National Museum. Through the efforts of Mr. Schellbach a start has been made on a check-list of the fishes of the Park, and some of this material has been included in the present report.

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BOTANY.—*Spot anthracnoses in the Pacific Coast States.*[1] ANNA E. JENKINS, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, A. A. BITANCOURT, Instituto Biologico, São Paulo, Brazil, and FLORA G. POLLACK, U. S. Bureau of Entomology and Plant Quarantine.

A summary of the distribution of spot anthracnoses[2] in the United States, prepared in 1938 (*6*) showed that five of these diseases had been recorded in the Pacific Coast States (Washington, Oregon, and California), viz:

(1) anthracnose of grape (*Vitis*), caused by *Elsinoë ampelina* (DBy) Shear;
(2) anthracnose of brambles (*Rubus*), caused by *E. veneta* (Burk.) Jenkins;
(3) anthracnose of snowberry (*Symphoricarpos*), caused by *Sphaceloma symphoricarpi* Barrus and Horsfall;
(4) anthracnose of rose (*Rosa*), caused by *S. rosarum* (Pass.) Jenkins;
(5) anthracnose of Labrador-tea (*Ledum*), caused by *E. ledi* (Pk.) Zeller.

All five diseases were known in Oregon and all but snowberry anthracnose and rose anthracnose in Washington. The exception for California was grape anthracnose, and the absence of this disease in that state has since been commented upon by Smith (*11*). The existence of gray scab of willow in California has been traced (*3*) by virtue of the presence of typical lesions of the diseases on herbarium specimens of *Salix lasiolepis* Benth. collected in Humboldt County (1933), Santa Clara County (1904), and San Diego County (1931). This disease was recognized as a spot anthracnose in 1943 (*9*) and its pathogene named *S. murrayae* Jenkins and Grodsinsky (*3*, p. 56) in honor of its discoverer.

Additional records of spot anthracnoses in the Pacific Coast States now available are assembled in this article, and in four instances their pathogenes are described as new. Findings in western Washington and Oregon are based on specimens emanating from the Special Survey in the General Vicinity of Ports of Entry of the U. S. Bureau of Entomology and Plant Quarantine (1943–45). These were referred to Jenkins because of their apparent spot anthracnose nature, and where identification or corroboration was sufficiently positive at the time they were reported in Field's *Summary of the more important plant diseases taken in connection with the . . . Survey . . .* (*1*). The spot anthracnose on salal (*Gaultheria shallon* Pursh), however, came to attention only in 1946, during routine examination of the particular Special Survey specimen concerned, by Pollack, recent coauthor in the description of a new species of *Elsinoë* (*10*). The new records of spot anthracnoses in southern California are afforded by specimens collected in that part of the state in 1942 by H. S. Fawcett and A. A. Bitancourt, together with certain specimens communicated to the first two writers by Fawcett.

As a result of the Special Survey, rose anthracnose was found in Pacific County, Wash. (*1*, 29, p. 182) and gray scab on Pacific willow (*Salix lasiandra* Benth.) both in Pacific County, Wash. (*1*, 28, p. 274; *5*) and in Clatsop County, Oreg.

Of particular significance was the discovery in western Washington and Oregon of a spot anthracnose not previously known in the United States, namely, anthracnose of pome fruits (*7*, *8*). The single finding on quince from Washington of what appears to be this disease (*8*) had been preceded by an earlier discovery in Brazil not previously reported. At Campinas, São Paulo, in June 1939, Bitancourt discovered presumably the same leaf spot on quince leaves, and isolated the pathogene. Following the initial discovery of this spot anthracnose in the Pacific Northwest, the Emergency Plant Disease Survey of the Bureau of Plant Industry, Soils, and Agricultural Engineering cooperated in a further search for this disease in western Washington and Oregon. The several counties in these states in which the disease was found during 1943–44 are indicated on a map (*8*).

Thus far anthracnose of pome fruits has

[1] Received November 5, 1946.
[2] Term adopted for collective reference to diseases caused by *Elsinoë* and *Sphaceloma*.

been reported only on leaves but in the case of apple also on fruit. An example of twig attack is available through a Brazilian interception of a diseased apple twig from Portugal, made in Santos, State of São Paulo, in 1932, by J. D. Deslandes. The specimen in question was identified by Bitancourt who found the perfect stage of

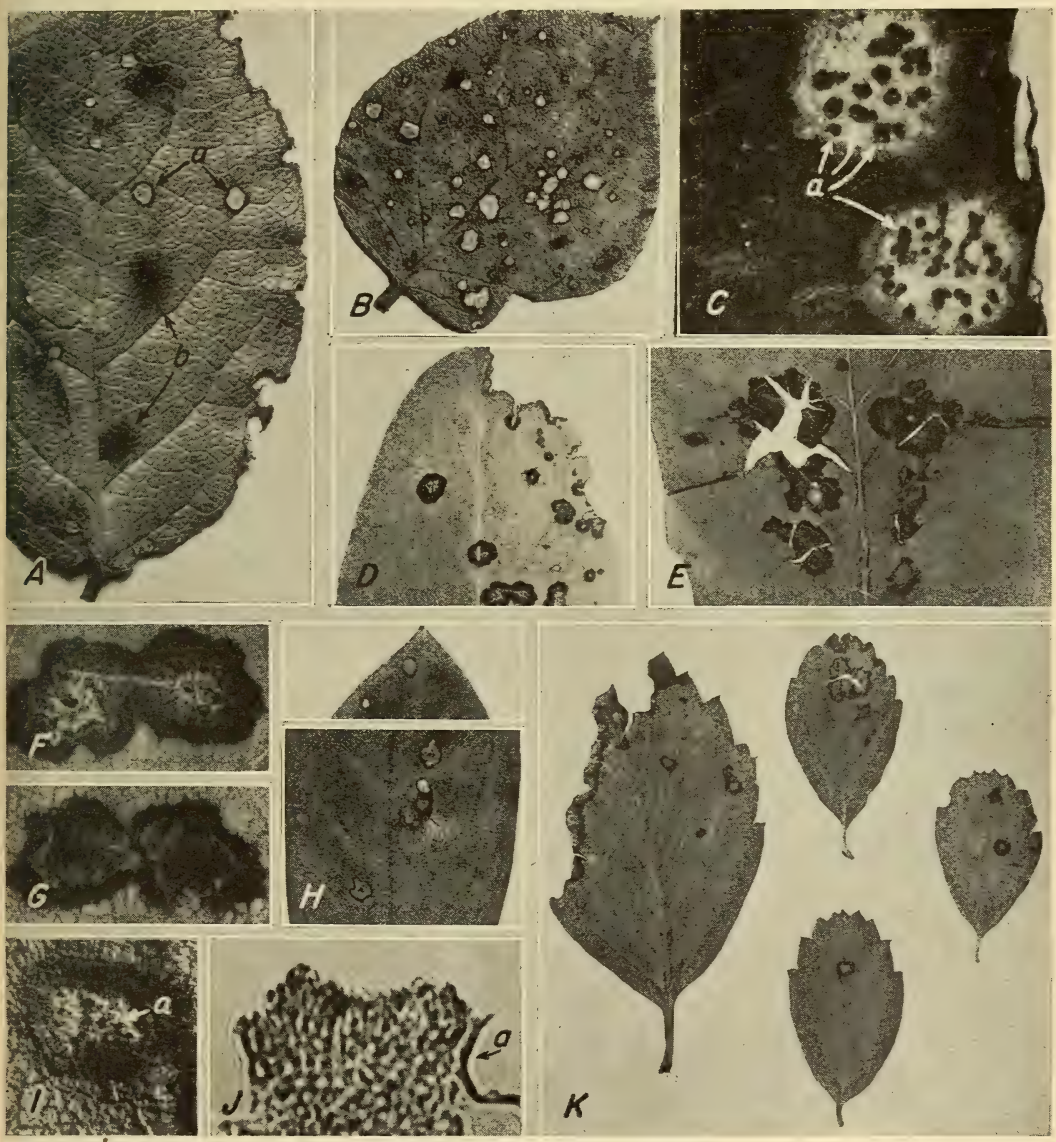


Fig. 1.—A–C, Lesions on *Gaultheria shallon* from western Washington: A, *a*, light-colored spots on upper leaf surface caused by *Elsinoë*, apparently *E. ledi*; *b*, dark spots caused by *Phyllosticta gaultheriae*, Special Survey collection, 1945, ×1. B, C, *Elsinoë* leaf spot on the Bartholomew specimen, 1909; B, ×1; *C*, *a*, ascomata, ×12. D–G, Leaf spot on *Arbutus menziesii* caused by *Sphaceloma mattirolianum* (?), specimen collected in California by Fawcett and Bitancourt, 1942; D and E, ×1; F, individual leaf spot from D, ×5; G, reverse of same leaf spot, ×5. H, *Sphaceloma* leaf spot on *Rhododendron macrophyllum*, Special Survey collection in western Washington, 1943, ×1. I, Leaf spot on *Cercocarpus betulifolium* var. *multiflorus* caused by *S. cerocarpi*, specimen collected by Fawcett and Bitancourt in California, 1942, *a*, acervuli, ×10. J, *a*, Fructification of *S. cercocarpi*, *a*, ruptured epidermis, ×500. K, *Cercocarpus* leaf spot, ×1. Photographs by R. L. Taylor (A–C, H), Bitancourt (D–G), and Lillian A. Guernsey (I–K).

the pathogene (*Elsinoë piri* (Woronich.) Jenkins) fruiting on the cankers. Only the conidial stage of the fungus (*Sphaceloma pirinum* (Pegl.) Jenkins) (*8*) was observed on the specimens from Washington and Oregon.

Among new suscepts of spot anthracnoses discovered as a result of the Special Survey are the two ericaceous plants, coast rhododendron (*Rhododendron macrophyllum* G. Don) and salal. In the case of coast rhododendron limited spotting on only two leaves was observed (Fig. 1, H). The collection was made in Skagit County, Wash., on August 31, 1943, and *Sphaceloma* sp. was definitely evident on the lesions.

The specimen on salal examined by Pollack is from Clallam County and is dated May 25, 1945. In addition to the light-colored, purple-margined *Elsinoë* leaf spot (Fig. 1, A, *a*) there is a less distinctive brown leaf spot surrounded by an indefinite discoloration (Fig. 1, A, *b*). This leaf spot is caused by *Phyllosticta gaultheriae* Ell. and Ev.

This same combination of leaf spots or apparently only the more conspicuous *Elsinoë* spot is represented in the Mycological Collections of the Bureau of Plant Industry as Pollack ascertained. Pertinent specimens are the following: Bainbridge Island, Kitsap County, Wash., July 23, 1909, E. Bartholomew (E. Barth. Fungi Columbiani no. 3160) (Fig. 1, B and C); Lake Isobel, Snohomish County, Wash., February 22, 1931, W. H. Wheeler; Grants Pass, Oreg., September 5, 1916, J. R. Weir 688 and 691. A fifth specimen of the *Elsinoë* found in the Mycological Collections and only now recognized as of that genus, transfers the first known record from Clallam County, Wash., to August 7, 1929. The collector of this earlier specimen is E. P. Meinecke.

In general appearance this spot anthracnose on *Gaultheria* resembles that of *Ledum*. In either case the *Elsinoë* produces the perfect stage abundantly and there is a similarity in the fructifications. Microscopic comparison of the *Elsinoë* on *Gaultheria* with an authentic specimen of *E. ledi* showing mature spores revealed no appreciable difference in the two species. Incidentally, the presence of muriform spores in *E. ledi* is mentioned here, as they are not noted in Zeller's (*12*) revised description of this species. On the basis of this favorable comparison with *E. ledi*, the *Elsinoë* on salal is identified for the present at least as that species. It remains to be determined, of course, whether the *Elsinoë* from either suscept is capable of infecting the other.

Among the findings of spot anthracnoses in southern California were those on the ericaceous genus *Arbutus*. On May 21, 1942, in the Santa Ana Botanical Gardens, Orange County, Fawcett and Bitancourt observed a prominent leaf spot on *A. menziesii* Pursh (Fig. 1, D–G), from which *Sphaceloma* was isolated by Bitancourt. This disease is identified tentatively at least as identical with anthracnose on leaves of strawberry-tree (*A. unedo* L.) caused by *S. mattirolianum* (Sacc. and D. Sacc.) Jenkins (*4*). What is evidently this disease of strawberry-tree was observed at Riverside, Riverside County, Calif., by Fawcett in January 1944. To the writers' knowledge, these constitute the first records of this particular spot anthracnose in United States. Other spot anthracnoses found in California are those of Catalina cherry (*Prunus lyonii* Sarg.) collected in Santa Barbara March 5, 1936, by M. W. Gardner; hollyleaf cherry (*P. ilicifolia* Walp.), Griffith Park, Los Angeles, October 12, 1939, by H. S. Fawcett, D. E. Bliss, and A. A. Bitancourt (811); and tree tobacco (*Nicotiana glauca* Graham), Ventura County, May 12, 1942, by Fawcett and Bitancourt (911).

FIG. 2.—A, B, Spots on leaves of *Ribes grossularia* caused by *Sphaceloma ribis*, Special Survey collection in Western Washington, 1943; A, ×1; B, ×3½. C, *a*, Acervulus of the *Sphaceloma*, *b*, ruptured epidermis, *c*, hyperplastic host tissue. D–F, Spots on *Viburnum opulus* var. *roseum* (D and F) caused by *S. viburni* (E): D, *a*, dark acervuli on a leaf spot, ×12; F, *a* acervulus, *b*, ruptured epidermis, ×500; F, ×1. G, H, Scab of *Hedera helix* caused by *S. hederae*, from California, 1942, comm. H. S. Fawcett: G, ×1; H, ×12. I–M, *S. hederae* on *H. helix* from North Carolina, Coll. and comm. Westcott: I, *a*, Fructification on a lesion, ×12; J, *a*, dark intraepidermal hyphae giving rise to conidiophores (*b*), *c*, ruptured epidermis; K–M, more mature development of the *Sphaceloma*, *a*, conidiophores, *b*, conidia, ×500. Photographs by Taylor (A, B, D, F, G, H, and I), Guernsey (C), and M. A. Jaeger (E and J–M).

The four remaining spot anthracnoses to be reported here appear to be new to science. Those found as a result of the Special Survey affect gooseberry (*1*, 29, p. 182) and snowball (*1*, 28, p. 970). The distribution of all four diseases will be given below follow-

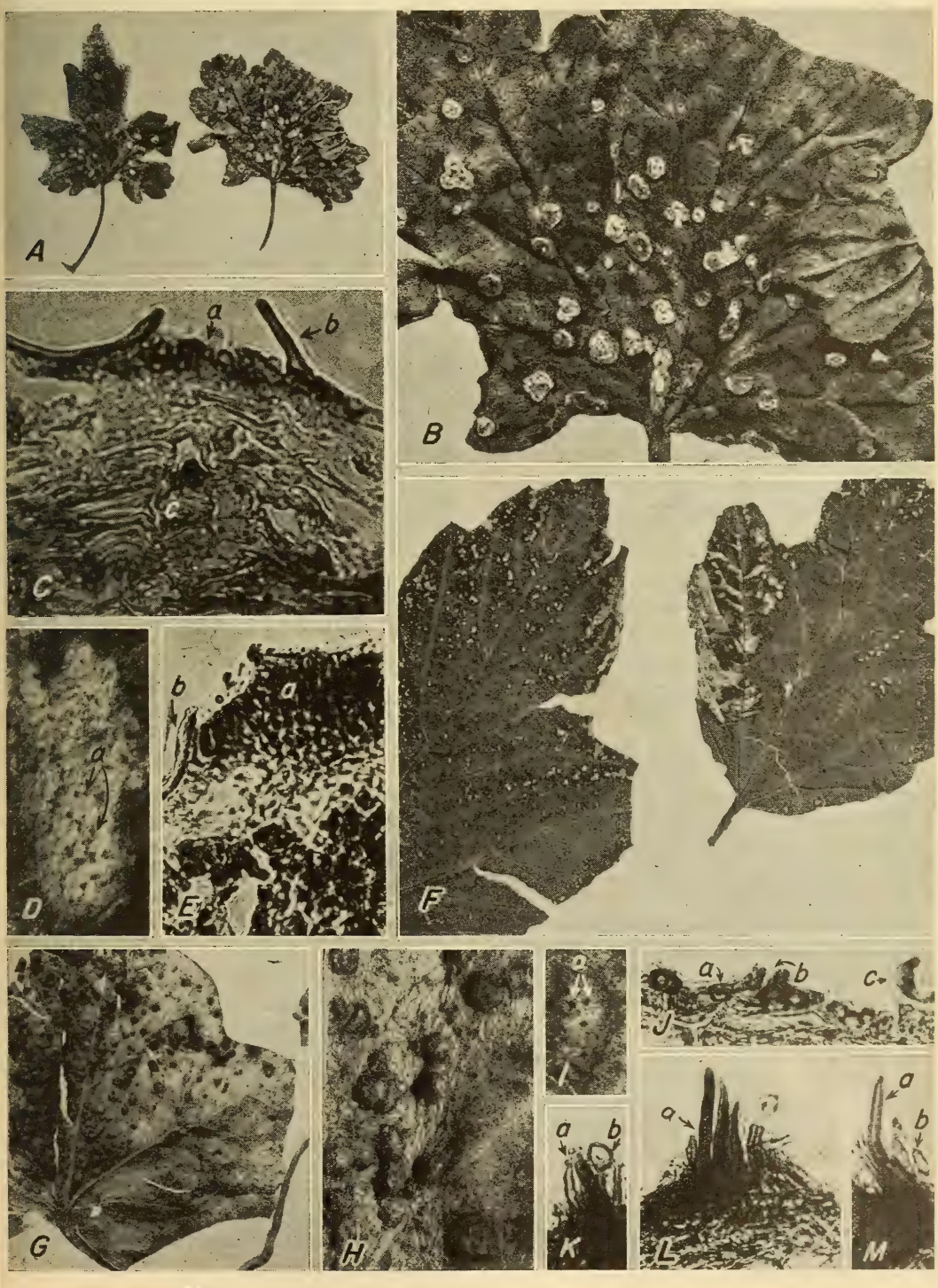


FIG. 2.—(See opposite page for legend.)

ing brief diagnoses of their pathogenes. The translations into Latin were made by Miss Edith K. Cash.

Sphaceloma ribis sp. nov., Jenkins and Bitancourt
FIG. 2, A–C

Maculae in foliis numerosae, conspersae, interdum in nervis circulares vel sub-circulares, aliquando paucae coalescentes, plerumque usque 1 mm in diam., supra prominentiores elevatae, griseae margine inconspicuo luteo ex acervulis atro punctatae; acervuli intraepidermales, dein erumpentes, usque 63μ in diam. et 40μ crassi; conidiophora obscura, continua vel 1–3 septata, usque 15μ, e stromate pallido oriunda; conidia variabilia, parva, hyalina vel colorata, sphaericalia usque 3μ in diam. ad elliptica, 8$\times$5μ.

Distribution.—Producing the disease "scab of gooseberry" on leaves of *Ribes grossularia* L. (Saxifragaceae) in Washington.

Specimen examined.—Chinook, Pacific County, Wash., October 9, 1943, R. F. Wilbur (Wilbur 53) (USM 74759, IB 4877, Type).[3]

Sphaceloma viburni sp. nov., Jenkins and Bitancourt
FIG. 1, D–F

Maculae in folis paucae usque numerosissimae, dispersae, etiam saepe nervisequentes vel marginales circulares usque triangulares vel irregulares, minutae ad 2 mm diam., vel plus minusve extensae, supra prominentiores, centro griseae usque albae, margine brunneo interdum ex acervulis atropunctatae, acervuli intraepidermales, dein erumpentes, compacti, pulvinati, usque 61–100μ in diam. et 21–50μ crassi; conidia non visa.

Distribution.—Producing the disease "anthracnose of snowball" on leaves of *Viburnum opulus* var. *roseum* L. and *V. suspensum* Lindl. (Caprofoliaceae) in Washington and California.

Specimens examined.—On *Viburnum opulus* var. *roseum* L.: Roseburg, Wakiakum County, Wash., October 8, 1943, F. S. Semans (Wilbur 148) (USM 74690, IB 4679 Type). Chinook, Pacific County, Wash., November 30, 1944, M. J. Forsell (Forsell 1167, 1168, 1169 and 1170).

On *Viburnum suspensum* Lindl.: Riverside, Riverside County, Calif., March 28, 1942, H. S. Fawcett, R. H. Buller, and A. A. Bitancourt 904 (USM 74384, IB 4402).

Sphaceloma cercocarpi sp. nov., Bitancourt and Jenkins
FIG. 2, I–K

Maculae in foliis plus minusve sparse conspersae, interdum marginales, circulares vel sub-circulares, interdum coalescentes, usque 3 mm diam., supra prominentiores, centro pallidae, interdum margine subelevato purpureo; acervuli in area centrali papuliformes, intraepidermales, dein erumpentes, compacti, pallidi, usque 57–60μ lati, 44–70μ crassi, interdum confluentes; stroma valde evolutum, stratum conidiferum pallidum, compactum, 26μ crassum; conidia non visa.

Distribution.—Producing the disease "anthracnose of birch-leaf mahogany" on leaves of *Cercocarpus betulifolius* var. *multiflorus* Jepson (Rosaceae) in California.

Specimen examined.—Santa Ana Botanical Gardens, Orange County, Calif., May 2, 1942, H. S. Fawcett and A. A. Bitancourt 910 (USM 74383, IB 4404, Type).

Sphaceloma hederae sp. nov., Bitancourt and Jenkins
FIG. 2, G–M

Maculae in foliis saepe numerosissimae, conspersae, vel in area una dense aggregatae, circulares vel subcirculares, verruciformes, interdum centro depressae, brunneae, centro pallido vel obscuro, saepe confluentes, infra prominentiores, 1–5 mm in diam., status *Sphaceloma* hyphomycetoideum potius quam acervuloideum; conidiophora ex hyphis intraepidermibus, in caespitibus usque 53–200μ in diam., aggregatis, in longitudinem variabilia, usque 47μ longa, 5.3μ lata, recta vel curvata, plerumque acuta vulgo continua, interdum 3-septata; conidia variabilia parva, hyalina vel colorata, sphaericalia, usque 6μ diam. vel elliptica, continua, ad septata, 2.5–7.8$\times$1.7–5.3μ.

Distribution.—Producing the disease "scab of English ivy" (*2*) on leaves of *Hedera helix* L. (Araliaceae), in California, North Carolina, and São Paulo, Brazil.

[3] USM = Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Plant Industry Station, Beltsville, Md. IB = Secção de Fitopatologia, Instituto Biologico de São Paulo, Brazil.

Specimens examined.—Vicinity of Silver Lake, Los Angeles County, Calif., May 28, 1940, R. G. Woglum (comm., H. S. Fawcett). Uplands, San Bernardino County, Calif., about June 1942, H. Cavers (comm. H. S. Fawcett). Mar Vista, Los Angeles County, Calif., March 8, 1943, A. Stein (comm. H. S. Fawcett).

Asheville, N. C., October 18, 1946 (Coll. and comm. C. Westcott) (USM 90270, IB 5101, Type).

São Paulo, Brazil, May 3, 1943, A. A. Bitancourt 972. Isolations were made from two of these specimens, that collected at Mar Vista and that São Paulo by Bitancourt.

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(8) JENKINS, A. E , FORSELL, M. J., and BOYLE, L. W. *Identity and known distribution of* Elsinoë piri *in Washington and Oregon.* Phytopathology **36:** 458–461, illus. 1946.

(9) JENKINS, A. E., and GRODSINSKY, L. Sphaceloma *on willow in New Zealand.* Trans. Brit. Mycol. Soc. **26:** 1–3, illus. 1943.

(10) LIMBER, D. P., POLLACK, F. G., and JENKINS, A. E. Elsinoë *discovered on* Sesbania *and* Cinnamomum *in the United States.* Mycologia **38:** 463–472, illus. 1946.

(11) SMITH, R. E. *Diseases of fruits and nuts.* Univ. California. Agr. Ext. Serv. Circ. 120, 168 pp., illus. 1941.

(12) ZELLER, M., and DEREMIAH, J. W. *An anthracnose of* Ledum *caused by a species of* Elsinoë. Phytopathology **21:** 965–972, illus. 1931.

ENTOMOLOGY.—*New species of North and Central American mites of the family Penthaleidae (Acarina).*[1]

EDWARD W. BAKER, *U. S. Bureau of Entomology and Plant Quarantine.* (Communicated by ALAN STONE.)

The family Penthaleidae Oudemans, 1931, is composed of four genera, two of which contain species of economic importance.

Essig[2] and Campbell[3] report that *Penthaleus major* (Dugès)[4] is a pest of peas in California and that it feeds on clover, oats, wild mustard, and lupine. Essig has also observed it attacking a springtail, *Achorutes armatus* Nicolet, which was swarming on the surface of ditch water. It has caused serious damage to wheat in certain areas in Texas and has been found on wheat and barley in Arizona and Oklahoma. In Australia this species is a serious pest of clover and vegetable crops,[5] and Andre[6] records it as injurious to peas and lettuce as well as other vegetables in France.

Halotydeus destructor (Tucker) causes extensive damage to vegetable and leguminous crops in Australia and South

[1] Received October 22, 1946.

[2] ESSIG, E. O. California Dept. Agr. Monthly Bull. **28** (7, 8, 9): 507–508, fig. 1. 1939.

[3] CAMPBELL, R. E. California Dept. Agr. Monthly Bull. **30** (3): 312–314. 1941.

[4] *Notophallus dorsalis* Banks, 1902 (Can. Ent. **34:** 172), and *N. viridis* Banks, 1917 (Ent. News **28:** 193), are here considered as synonyms of *Penthaleus major* (Dugès) (new synonymy).

[5] SWAN, D. C. Journ. Agr. Res. South Australia **38:** 365–367. 1934.

[6] ANDRÉ, MARC. Bull. Paris Mus. Hist. Nat. (2) **4:** 284–291. 1932.

Africa,[7,8,9,10] but as far as is known it is not present in North America. A mite identified as *Halotydeus egregius* (Berlese) has been taken from peach-orchard soil in Texas, but as yet this species has not proved to be of economic importance.

The genera *Stereotydeus* and *Penthalodes* are represented in the United States, Mexico, and Panama by the new species described in this paper. These do not appear to be harmful and possibly they are predaceous, but since they belong to a family that contains species of economic importance they are described.

Penthalodes mytilaspidis Riley, as described and figured by McGregor,[11] appears to belong to another family, perhaps the Anystidae.

KEY TO THE GENERA

1. Anal opening not ventral.....2
   Anal opening ventral.....3
2. Anal opening dorsal...*Penthaleus* Koch, 1835
   Anal opening posterior.....
   .....*Halotydeus* Berlese, 1891
3. No V-shaped indentation on dorsum of body
   .....*Stereotydeus* Berlese & Leonardi, 1901
   A V-shaped indentation on dorsum of body..
   .....*Penthalodes* Murray, 1877

Stereotydeus mexicanus, n. sp.

FIGS. 1, 2

Female.—Skin pattern reticulate, forming independent pentagons separated from one another by about their own width on dorsal and lateral surface of mite. On venter of mite between coxae pentagons lacking, only tubercles without pattern present. Palpus strong, segment II especially broad; segment I, 17μ long; II, 67μ long with two dorsal pilose setae; III, 18μ long with three pilose setae; IV, 23μ long with apparently seven small distal setae, one of which appears to be simple and the others pilose. Shield over rostrum trilobed, center lobe pointed, with same pattern as body; median anterior tubercle with a pair of short pilose setae. A pair of pilose sensory setae about 66μ long; other dorsal body setae about 25μ long, pilose. A pair of medium-sized eyes behind lateral propodosomal dorsal setae. Six pairs of long, pilose genital setae, the fourth from the anterior edge of the plate set laterad from the others. Leg setae short, pilose; tarsus I with three sensory organs arranged in a single row. Body rounded posteriorly. Length of body 380μ; including rostral shield 453μ; width about 266μ.

Male.—Similar to female.

The type female. U.S.N.M. no. 1697, was collected at Patzcuaro, Michoacán, Mexico, September 1, 1941, by F. Bonet; a paratype, to be deposited in the collection of F. Bonet, Mexico, D. F., was collected in moss, Orizaba, Veracruz, Mexico, February 21, 1943, by F. Bonet. Other collection records are as follows: On orchid plant, Mexico at Brownsville, Tex., September 27, 1942, by Williamson; in moss, Mount Popocatapetl, Mexico, at about 9,000 feet elevation, December 29, 1942, by E. W. Baker; in moss, Laguna de Zempoala, Morelos, Mexico, January 31, 1943, by E. W. Baker; in moss, Desierto de los Leones, México, Mexico, November 19, 1943, by C. C. Plummer. The following Mexican collections were made by F. Bonet: In moss, Salazar, D. F., September 30, 1942; in mushrooms, Desierto de los Leones, Mexico, July 14, 1941; Nevada de Toluca, Mexico, April 27, 1941; Gruta del Palmito, Bustamante, Nuevo León, July 17, 1942; wood, Orizaba, Veracruz, January 14, 1941; in moss, Cuesta de Acultzingo, Veracruz, January 10 and 16, 1942; Nevada de Colima, Colima, January 20, 1943.

The mite is similar to the Australian species, *Stereotydeus occidentale* Womersley, but it differs in that the dorsal pattern of *S. mexicanus* is composed of minute tubercles, forming pentagons, while that of *S. occidentale* is made up of small uniform tubercles separated by their own diameter; the dorsal setae of *S. mexicanus* are longer; *S. mexicanus* is 453μ long and *S. occidentale* is 650μ long; and the palpal segments of the Mexican species are longer.

Stereotydeus lattimorei, n. sp.

FIG. 3

Female.—Skin pattern not reticulate but composed of tubercles forming longitudinal striations over dorsum of mite, and more or less transverse striations on venter. Palpus short,

[7] JACK, R. W. Agr. Journ. Cape of Good Hope 32: 615–620. 1908.
[8] TUCKER, R. W. E. Union South Africa Dept. Agr. Mem. 3: 23–36. 1925.
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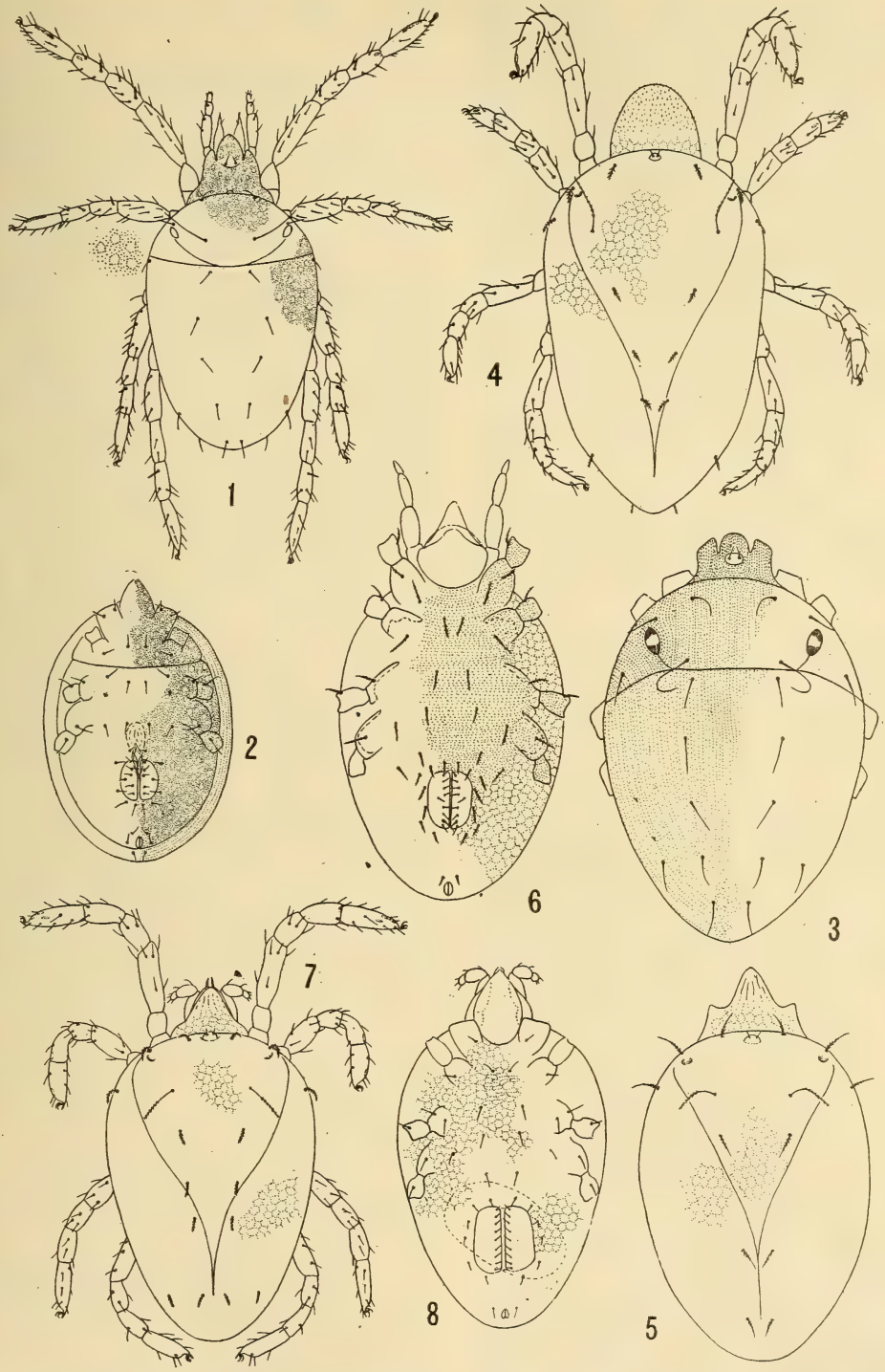


FIG. 1.—*Stereotydeus mexicanus*, n. sp. Dorsal view of body, male. FIG. 2.—Same, ventral view, male. FIG. 3.—*Stereotydeus lattimorei*, n. sp. Dorsal view of body, female. FIG. 4.—*Penthalodes oregonensis*, n. sp. Dorsal view of body, female. FIG. 5.—*Penthalodes boneti*, n. sp. Dorsal view of body, female. FIG. 6.—Same, ventral view, male. FIG. 7.—*Penthalodes turneri*, n. sp. Dorsal view of body, female. FIG. 8.—Same, ventral view, female.

strong; segment I, 20μ long; II, 83μ long, with two dorsal, pilose setae; III, 33μ long, with three pilose setae; IV, 27μ long, rounded, with several short terminal setae. Shield over rostrum trilobed, the center lobe rounded, with same pattern as body; median anterior tubercle with a pair of finely haired setae. A pair of pilose sensory setae not much longer than the pilose body setae, which are about 60–70μ long. A pair of large eyes on propodosoma. Genital setae arranged as in *S. mexicanus* with one pair laterad from the others; possibly six pairs of genital setae although only five pairs seen. Leg setae short, pilose; tarsus I with the usual three sensory organs. Body slightly pointed to rear. Length of body 1,000μ, including rostral shield 1,142μ; width about 700μ.

The type female, U.S.N.M. no. 1698, was collected "with orchid roots," from the Canal Zone, at Brownsville, Tex., February 8, 1946, by R. B. Lattimore, for whom the mite is named.

The large size and lack of reticulations distinguish this species from others in the genus.

Penthalodes oregonensis, n. sp.

FIG. 4

Female.—Dorsum of body with V-shaped indentation, skin pattern of tubercles forming connecting hexagons, covering dorsum and entire venter of mite. Palpus of moderate length and thickness; segment I, 20μ long; II, 40μ long with two short, semiplumose setae; III, about 23μ long with three short, semiplumose setae; IV, 10μ long with apparently 6 short terminal setae, 2 of which appear simple and the others pilose. No reticulate pattern on shield over rostrum, but posteriorly a few tubercles and anteriorly with fine hairs; shield broadly rounded, entirely covering rostrum. Anterior median tubercle on propodosoma with a pair of simple setae. Propodosomatic sensory setae of medium length, pilose; other dorsal body setae pilose, shorter. Possible eye lens present on anterior lateral portions of propodosoma. Nine pairs of pilose genital setae, the middle one laterad of the others. Tarsus I with three rodlike sensory organs, the posterior one placed laterad of the other two, which are in line. Body pointed posteriorly. Length of body 327μ; including rostrum 380μ; width 200μ.

The type, U.S.N.M. no. 1699, and a single paratype were taken from fir duff, Corvallis, Oreg., October 28, 1939, collector unknown.

The rounded shield over the rostrum is distinctive of this species.

Penthalodes boneti, n. sp.

FIGS. 5, 6

Female.—Dark brown with lighter dorsoposterior and ventral spots; legs light red. Body rounded, V-shaped indentation present; the reticulate pattern, which is composed of tubercles, covers the entire dorsum, and laterally and ventrally the reticulations reach the coxae and the genital plates, but between the area formed by the coxae and genital plates the pattern is no longer reticulate, but entirely tuberculate. Palpi long, slender; segment I, 20μ long; II, 67μ long, with a long pilose median seta and a similar distal seta; III, 63μ long, with a posterior seta of medium length and two similar distal setae; IV, 27μ long, with a basal rodlike sensory organ and at least five terminal setae, one of which appears to be simple, the others pilose. Shield over rostrum small, triangular, with shoulders, the shield reticulate posteriorly and striate anteriorly. Anterior median propodosomatic tubercle with two short, simple setae. Propodosomatic sensory setae pilose on distal portion; dorsal setae pilose. A pair of lenslike eyes present. Nine pairs of genital setae, the middle seta laterad of the others, which are near the inner margin of the genital plate. Tarsus I with 3 rodlike sensory setae, the posterior one laterad of the other two, which are in line; tarsus II with three rodlike sensory setae, all in line. Length of body 433μ; including rostral shield 513μ; width about 333μ.

Male.—Similar but slightly more elongated.

The type female, U.S.N.M. no. 1700, was collected in moss, Desierto de los Leones, Mexico, December 5, 1943, by E. W. Baker, and two paratypes, to be deposited in the collection of F. Bonet, Mexico, D. F., were collected from moss, Cumbre de Acultzingo, Veracruz, Mexico, January 16, 1942, by F. Bonet. Other Mexican collections are as follows: In bark, Atoyac, Veracruz, November 13, 1941, by F. Bonet; in moss, Desierto de los Leones, Mexico, July 14, 1941, by F. Bonet; in moss, Cuernavaca, Morelos, August 26, 1939, by F. Bonet; in rotten wood, Cuautla, Morelos, July 8, 1941, by F. Bonet; in moss, Desierto de los Leones, Mexico, February 7, 1943, by E. W. Baker.

The lack of ventral reticulation and the type of dorsal setae are distinctive of this species.

The reticulate pattern is similar to that of *Penthalodes ovatus* (Koch), but *P. boneti* possesses dorsal and posterior setae whose lateral branches are short, whereas in *P. ovatus* the branches are fewer and may be as long as the main stem.

Penthalodes turneri, n. sp.

FIGS. 7, 8

Female.—Dorsum of body with V-shaped indentation; skin pattern of connecting hexagons over entire dorsum and entire venter. Palpi long, slender; segment I, 20μ long; II, 40μ long, with a median and a distal nearly semiplumose setae; III, 40μ long, with a basal and two distal semiplumose setae; IV, 20μ long, with apparently six short pilose setae. Shield over rostrum small, triangular, reticulate posteriorly and striate anteriorly. Anterior median tubercle of propodosoma with two short simple setae. Dorsal body setae almost semiplumose, with three to five lateral branches; anterior dorsal setae 6-rayed; propodosomatic sensory setae pilose on distal half. Genital setae as in other species. Tarsi I and II as in other species. Length of body 286μ; including rostral shield 333μ; width about 214μ.

The type female, U.S.N.M. no. 1701, a paratype and 4 other specimens were collected in peach-orchard soil, Stoddard County, Mo., September 25, 1936, by W. F. Turner. Other specimens were collected as follows: In soil, Tyler, Tex., November 23 and 24, 1939, and February 23, 1938 by L. D. Christenson; in soil, Denison, Tex., February 19, 1938, by L. D. Christenson; in soil, Menard, Tex., November 4, 1943, by O. A. Babcock; in rubbish in cottonfields, Batesburg, S. C., February 19, 1910, by H. F. Wilson.

This species is distinctive in that the reticulate pattern covers the dorsum and entire venter, and in the different type of dorsal body setae.

ENTOMOLOGY.—*Synopsis of the genus* Nealyda *Dietz, with descriptions of new species (Gelechiidae: Lepidoptera).*[1]

J. F. GATES CLARKE, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. MUESEBECK.)

The monobasic genus *Nealyda* was erected by Dietz[2] for *Nealyda bifidella* Dietz. Under the genus *Didactylota* Walsingham[3] described the West Indian *bicolor*. Busck[4] stated that this species was certainly referable to *Nealyda*, but the generic transfer was not made until 1925 by Meyrick.[5] In 1900 Busck[6] added two more species, *N. pisoniae* and *N. kinzelella*. Later Meyrick[7] described *N. accincta* and *N. leucozostra* and in this paper two new species, *neopisoniae* and *phytolaccae*, are added, bringing to a total of eight the number of described species in the genus.

With the exception of *bifidella*, which ranges as far west and north as Washington State, the species are tropical or subtropical.

All the larvae so far known are leaf miners forming a blotch mine. Pupation occurs either inside or outside the mine, but the pupa always is in a flat, whitish or tinted cocoon from which it does not protrude at the time of emergence of the adult.

KEY TO THE SPECIES OF NEALYDA

1. Labial palpus conspicuously annulated.....2
   Labial palpus not so marked.....6
2. Head light colored.....3
   Head dark colored.....5
3. Dark fascia before middle of forewing dark brown to black.....4
   Dark fascia before middle deep velvety brown .....*kinzelella* Busck
4. Tuft of scales on dorsum contrastingly darker than dark fascia.....*pisoniae* Busck
   Tuft of scales on dorsum not darker than fascia .....*phytolaccae*, n. sp.
5. Median light fascia of forewing with blotch of dark color in center.....
   .....*neopisoniae*, n. sp.
   Median light fascia without such blotch of dark color.....*bifidella* Dietz

[1] Received November 7, 1946.

[2] DIETZ, W. G., Ent. News **11**: 350. 1900.

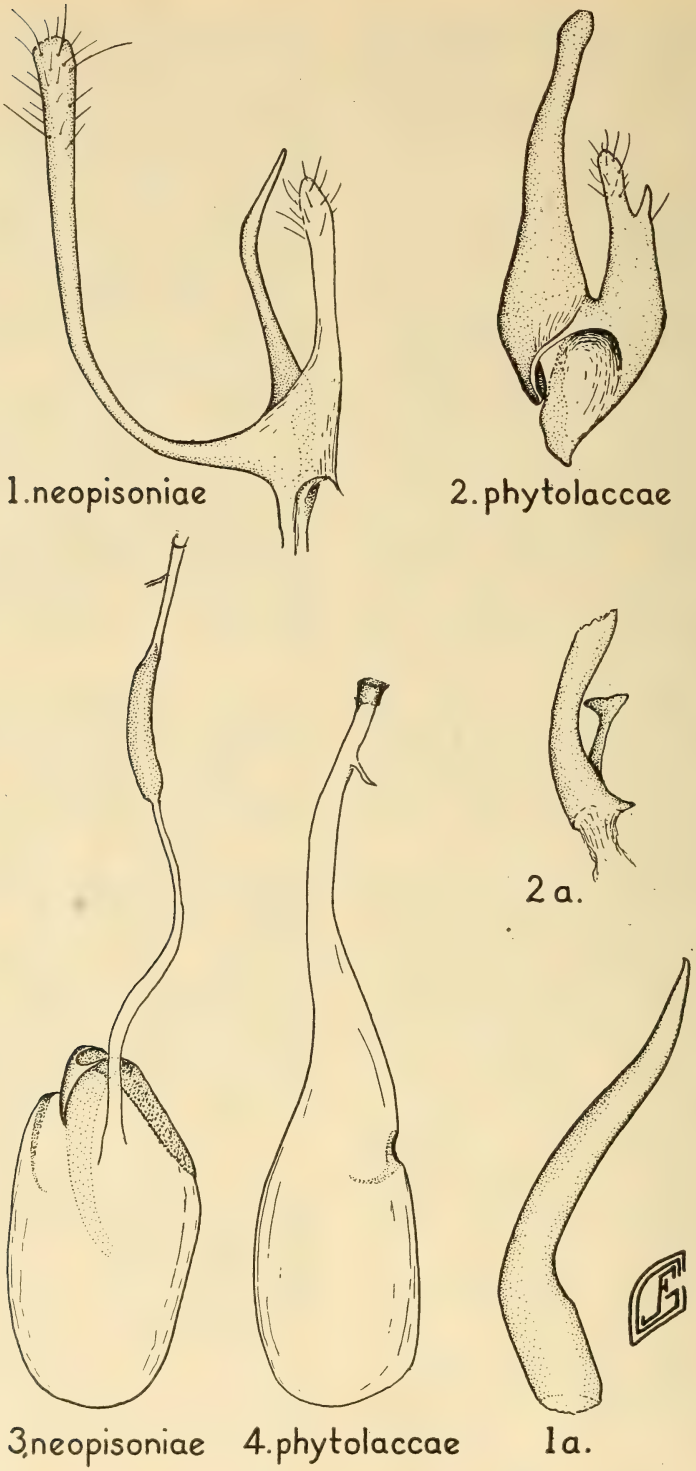
[3] WALSINGHAM, LORD, THOMAS DE GRAY, Proc. Zool. Soc. London, 1891: 522.

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[5] MEYRICK, E., *in* Wytsman, *Genera insectorum*, fasc. **184**: 24. 1925.

[6] BUSCK, A., Proc. U. S. Nat. Mus. **23**: 229, 230. 1900.

[7] MEYRICK, E., *Exotic Microlepidoptera* **3**: 5. 1923.



FIGS. 1–4.—1–1a, *Nealyda neopisoniae*, n. sp.: 1, Inner surface of right harpe; 1a, aedeagus, lateral view. 2–2a, *Nealyda phytolaccae*, n. sp.: 2, Inner surface of right harpe; 2a, aedeagus, lateral view. 3, *Nealyda neopisoniae*, n. sp.: Ventral view of bursa copulatrix and ductus bursae. 4, *Nealyda phytolaccae*, n. sp.: Ventral view of bursa copulatrix and ductus bursae.

6. Fine, leaden, metallic lines before and beyond tornus.....*accincta* Meyrick
No such metallic lines.....7
7. Basal half of forewing gray.*leucozostra* Meyrick
Basal half of forewing fawn color.....
.....*bicolor* (Walsingham)

Nealyda phytolaccae, n. sp.

Labial palpus black and white annulated. Antenna annulated black and white. Head pale luteous overlaid with fuscous. Thorax and tegula blackish fuscous to black basally shading to pale luteous. Forewing light yellowish brown basally shading to blackish fuscous or black slightly before middle where there is a sharp line of demarcation, with the lighter basal shade repeated followed by a gradual shading to blackish fuscous or black at apex; at apical fourth, on costa, a few whitish scales continue across wing as an ill-defined transverse line; cilia fuscous strongly overlaid with blackish fuscous and black. Hind wing and cilia fuscous; from costa, on underside of male, a yellowish hair pencil. Legs sordid white overlaid and annulated with blackish fuscous. Abdomen blackish fuscous above, paler beneath.

Male genitalia.—Dorsal lobe of harpe slender, slightly constricted before apex, extending beyond uncus; ventral lobe broad, about two-thirds the length of dorsal lobe, with divided distal end. Aedeagus slender, curved, simple. Vinculum with long, pointed, lateral processes.

Female genitalia.—Ductus bursae with a narrow sclerotized ring before ostium; inception of ductus seminalis well before ostium; signum a small, weakly sclerotized hook.

Alar expanse, 6–8 mm.

Type.—U.S.N.M. no. 58211.

Type locality.—Stock Island, Fla.

Food plant.—*Phytolacca decandra* L.

Described from the male type (21-III-1945) and eight male and eight female paratypes from the type locality and Bonefish Key, Fla., all showing March 1945 dates and reared from larvae collected by C. L. Griswold.

Paratypes in the United States National and British Museums.

This species is nearest to *N. pisoniae* Busck in genitalia but differs from it by the narrow dorsal lobe and the divided ventral lobe of the harpe.

Nealyda neopisoniae, n. sp.

Labial palpus black and white annulated. Antenna black with white annulations. Head, base of thorax and tegula and extreme base of forewing blackish fuscous with minute white irrorations; remainder of thorax and tegula, and forewing to one-third, pale fawn; from basal third to middle and again at apical third are bands of dark golden brown separated by a fascia of pale fawn; in the center of this fascia is a blackish fuscous blotch with minute white irrorations; a dorsal tuft at center and the apical fourth of wing, including the cilia, also blackish fuscous. Hind wing and cilia very dark fuscous; from costa, on underside, in male, a white hair pencil. Legs blackish fuscous irrorated and annulated with white. Abdomen fuscous.

Male genitalia.—Harpe with dorsal arm divided, U-shaped; one element extending beyond uncus, dilated distally, the other element shorter, sharply pointed; ventral lobe fleshy, weak, about one-half the length of the long dorsal element. Aedeagus long, curved, simple, pointed. Vinculum divided into two broad posterolateral processes.

Female genitalia.—Ductus bursae with a sclerotized area from middle to posterior fourth; inception of ductus seminalis well before ostium. Signa a large three-pointed curved plate and a short narrow sclerotized lateral plate.

Alar expanse, 6–7 mm.

Type.—U.S.N.M. no. 58212.

Type locality.—Jaimanitas, Habana Province, Cuba.

Food plant.—*Pisonia aculeata* L.

Described from the male type, one male and two female paratypes as follows: Jaimanitas, Habana Province, two males (22-25-IV-1934, A. R. Otero); Central Jaronú, two females (25-XI-30, L. C. Scaramuzza).

This species can be distinguished from all other members of the genus by the divided dorsal element of the harpe and the large signum.

ORNITHOLOGY.—*New subspecies of birds from peninsular Siam.*[1] H. G. Deignan, U. S. National Museum. (Communicated by Herbert Friedmann.)

I

Study of the birds of southern Siam has disclosed that two more peninsular forms, a kingfisher and a shrike babbler, may be awarded subspecific recognition. For the former, I propose the name—

Halcyon concreta peristephes,
n. subsp.

Type.—Adult male, U.S.N.M. no. 330226, collected at Khao Luang (lat. 11° 40′ N., long. 99° 35′ E.), a mountain southwest of Prachuap Khirikhan (Ko Lak), southwestern Siam, on October 6, 1930, by Hugh McCormick Smith (original number 4235).

Diagnosis.—From *concreta* of Sumatra and the M lay States, distinguished in either sex by greater measurements (wing: 111–115 mm, against 102–110 mm; tail: 58.4–63.6 mm, against 49.6–56.7 mm); by having the rufous of the collar and underparts slightly paler, and the center of the abdomen much more decidedly and extensively albescent; and, in the female, by having the buffy-white terminal spots on the scapulars and upper wing coverts somewhat larger in size.

Range.—Peninsular Siam from Trang Province at lat. 11° 40′ N.; southernmost Tenasserim.

Remarks.—*H. c. borneana* of Borneo agrees with *peristephes* in measurements but matches *concreta* in color characters.

II

The white-browed shrike babbler of the mountains of Peninsular Siam has always been treated as inseparable from *aeralatus* of northernmost Tenasserim and northwestern Siam, with which it agrees well enough in color; it proves to be a considerably smaller race, which I intend to call—

Pteruthius erythropterus schauenseei,
n. subsp.

Type.—Adult male, U.S.N.M. no. 311095, collected at 4,000 feet on Khao Luang (lat. 8° 30′ N., long. 99° 45′ E.), a mountain west of Nakhon Si Thammarat, peninsular Siam, on July 20, 1928, by Hugh McCormick Smith (original number 2260).

Diagnosis.—From *aeralatus*, separable only by its shorter wing. Six males of *schauenseei* have this measurement 69–77 mm (average: 73.5 mm), while 22 males of *aeralatus* have it 78–82 mm (average: 79.8 mm); three females of *schauenseei* have it 72.75 mm (average: 73.3 mm), while 24 females of *aeralatus* have it 76–83 mm (average: 79.3 mm).

Range.—Isolated mountains of peninsular Siam. The populations of the mountains of the Malay States are variably intermediate between *schauenseei* and *cameranoi* (Sumatra).

Remarks.—*P. e. robinsoni* of Borneo agrees with *schauenseei* in measurements but differs from both *schauenseei* and *aeralatus* in the deeper gray of the upperparts and the stronger pinkish wash on the flanks.

[1] Published with permission of the Secretary of the Smithsonian Institution. Received September 30, 1946.

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ETHNOLOGY.—*Powhatan Algonkian bird names: The Aushouetta (Topsell) or the Ahshowcutters (Strachey)*: Richmondena cardinalis.[1] CHARLES EDGAR GILLIAM, Petersburg, Va. (Communicated by JOHN R. SWANTON.)

Bayard H. Christy, in an article in The Auk, July 1933, entitled *Topsell's 'Fowles of Heaven,'* suggests that the bird called Aushouetta by Topsell is the thrasher(?). John R. Swanton in *Newly discovered Powhatan bird names* (Jour. Washington Acad. Sci. 24 (2). Feb. 15, 1934), from an analogy to the Penobscot skunt·és, meaning "little fire" or "little flame," supplied by Speck, indicates the name Aushouetta refers to the redstart (*Setophaga ruticilla*), pointing out that in Cuba the redstart is called candelita for the same reason.

The European redstart is a quite similar bird, but belongs to the family Sylviidae. It is known in Spain as candelita, suggesting the Cuban usage is of Old World rather than native New World origin. Smith gives the Powhatan Algonkian for "fire" as Pokawater and for "little" the words tanks and chawopo. Such considerations cast some doubt upon the Penobscot analogy furnishing a reliable clue of identity in this instance.

No trained ornithologist is known to have been in this colony during the period covered by the manuscripts involved. Topsell is not known to have been in America. One may assume that his drawing was made from a description furnished by some layman, who actually saw the bird.

Among those in this colony about that time was William Strachey. He came with the announced intention of observing and recording. He landed at Jamestown on June 10, 1610, and was back in his lodgings at Greyfriars, London, long enough before December 13, 1611, to complete and register for publication on that date his little volume *Laws (for the Colony of Virginia)*. The important fact is that he was in Virginia and observed and recorded.

His few known manuscripts indicate that he was acquainted with many branches of knowledge, though far from a finished scholar in any. Where he possessed technical knowledge, he was fond of displaying it, however imperfect and faulty. He noted most birds he saw by what he believed their English names to be but recorded only a few native bird names. The inference is that he had no ornithological knowledge and asked for the native names of birds the like of which he had never heard of or seen at home. He saw a bird native to Powhatan lands notable for its "carnation-coloured wings," and preserved its Algonkian name as Ahshowcutters (also spelt Awshocutteis). There is no doubt that both he and Topsell tried with slightly different results to record in the phonetics of the English alphabet the same word.

The identify of this bird would seem to be most accurately arrived at by inquiring what bird common to Powhatan lands to a lay mind most nearly meets these specifications: (1) Not native in any form in England; (2) thrasherlike in over-all appearance; and (3) readily identified by carnation-colored wings.

Scientifically speaking *Setophaga ruticilla* and *Toxostoma rufum* are both native to America, but popularly speaking redstarts and so-called "thrashers" are both common in Europe. Topsell's drawing proves that the Aushouetta was not a redstart; Strachey's descriptive phrase, that it was not a thrasher. The layman would hardly

[1] Received June 14, 1946.

confuse *Setophaga ruticilla* with *Toxostoma rufum.* Nor would the layman be likely to say that either had red wings. The brown thrasher has no really red coloring in its feathers; it is brown. The redstart is mostly black with a few red feathers in wing and tail.

There is, however, a bird native to Powhatan lands and unknown as well by scientists as by laymen in any form in Europe. In sweep of tail, wings, size, and over-all appearance, a layman might well consider it thrasherlike. This is more true of the female than of the male. Almost any ornithologist would glance once at its beak, note the difference from the characteristic thrasher beak, and conclude it is not thrasherlike at all. But laymen are prone to overlook such scientifically conclusive identifying details.

This bird is migratory through and a year-round sojourner in Powhatan lands. It was first classified by English ornithologists as *Cardinalis virginiensis;* by modern American birdmen as *Richmondena cardinalis.* In winter it often flocks in groups of eight or more pairs. It is the carnation-colored winged bird of Powhatan countries. Accepting the Penobscot analogy as valid without the diminutive, it is the veritable flame of Virginia tidewater woodlands and lawns.

We are aware that our methods are based on practical rather than scientific and technical considerations. But the methods used are the same as those by which Topsell's drawing and Strachey's description most likely were arrived at in the first place. Although we acknowledge that we may not have established the identity beyond all possibility of rational dispute, we feel that properly construed, the available evidence justifies the assertion that the *Aushouetta* and the *Ahshowcutters* are one and the same bird, and that bird is the cardinal.

ENTOMOLOGY.—*Notes on Oecophoridae, with descriptions of new species.*[1]

J. F. Gates Clarke, U. S. Bureau of Entomology and Plant Quarantine.

Since the publication of my revision of the North American Oecophoridae[2] much additional material and information have come to hand. The purpose of this paper is to bring this information together and publish it as a supplement to my former work. In December 1945 I was able to study certain types of Walker, Zeller, and Meyrick, in the British Museum. With information obtained from this study it is now possible for me to correct some erroneous conceptions and to place properly species formerly known only from descriptions. In this paper eight species are described as new, and notes on distribution, food plants, and synonymy are given on thirty others. I take this opportunity also to correct some errors that occurred in my revision.

The accompanying drawings were made and the plates composed by Arthur D. Cushman, chief scientific illustrator, Bureau of Entomology and Plant Quarantine.

Unless otherwise indicated specimens were collected and reared by the author.

For purposes of brevity references to my revision in the text are given by page or plate numbers only.

Agonopterix fulva (Walsingham)

Depressaria fulva Walsingham, Trans. Amer. Ent. Soc. **10**: 175. 1882.

Depressaria endryopa Meyrick, *Exotic Microlepidoptera* **2**: 223. 1918. (New synonymy.)

I have studied the unique type in the British Museum. The strikingly distinct genitalia of this species are unmistakable, and I do not hesitate to reduce Meyrick's name to synonymy.

Agonopterix oregonensis Clarke

Since describing this species in my revision I have reared a series of over a hundred specimens, from several hosts listed below, from various localities in California and Washington.

[1] Received December 2, 1946.

[2] Clarke, J. F. Gates, *Revision of the North American moths of the family Oecophoridae, with descriptions of new genera and species.* Proc. U. S. Nat. Mus. **90**: 33–286, pls. 1–48. 1941.

The species will be found through most of western North America because of its rather general feeding habits.

The California localities are as follows: Cottonwood, Tehama County; Pacheco Pass; Presidio of Monterey and Marina, Monterey County; Hunter Liggett Military Reservation, San Luis Obispo County. Washington: Gilmer and Husum, Klickitat County. In addition I have received 11 specimens from Dr. W. Harry Lange, from San Juan Bautista, Calif., reared from a species of *Sanicula*.

The larvae from the California localities were collected in February, March, and April, and those from Washington in May. The moths emerged through April and May to the 5th of June.

Larva: Length 12–14 mm. Head and thoracic shield black, the latter bisected by a fine brown line. First thoracic segment light brown, the legs and spiracles black. Second and third thoracic and abdominal segments dull yellowish infused with grayish dorsally. Setae brown. Spiracles narrowly edged with black. The prepupal larva has three well-defined grayish dorsal lines and the three terminal segments edged with grayish. Larvae of this species collected at Hunter Liggett Military Reservation differ from the above in having the second and third pairs of thoracic legs with tibia and tarsi brownish to black exteriorly.

Food plants.—Eryngium vaseyi Coult. & Rose, *Lomatium caruifolium* (H. & A.) Coult. & Rose, *L. marginatum* (Benth.) Coult. & Rose, *L. nudicaule* (Pursh) Coult. & Rose, *L. utriculatum* (Nutt.) Coult. & Rose, *Sanicula bipinnata* H. & A., *S. bipinnatifida* Dougl., *S. laciniata* H. & A., *S. nevadensis* S. Wats., and *S. tuberosa* Torr.

Agonopterix nebulosa (Zeller)

The food plant of this species, not previously recorded, is a species of *Antennaria*. I now have a series of one ♂ and four ♀♀, the larvae of which I collected at Lakeview, Chesterfield County, Va. The moths emerged from May 26 to 30, 1942.

The larva of this species ties the leaves of the host, as does its near relative *antennariella*.

Agonopterix fusciterminella Clarke

The range of this species is apparently wide. Originally it was described from material from British Columbia and California. I now have it from New Mexico (♂, 2♀♀, July 24–31; no collector) and Manitoba (♀, Winnipeg; no date or collector).

Agonopterix rosaciliella (Busck)

The first specimens of this species from California were submitted by Edward C. Johnston, of Seattle, Wash. They are from the following localities: Inverness, Marin County, three ♂♂ (28-I-40); Spring Mountain, Sonoma County, ♂, ♀ (16-III-39, 26-I-40).

Agonopterix pallidella (Busck)

Depressaria pallidella Busck, Proc. U. S. Nat. Mus. **27**: 765. 1904.

Depressaria sciadopa Meyrick, *Exotic Microlepidoptera* **2**: 315. 1920. (New synonymy.)

There are two males of *sciadopa* Meyrick in the British Museum, both in poor condition. Of these I have selected the smaller one as the lectotype. This specimen is labeled "Field, British Columbia (4000 ft., A.J.T., 28-8-18)."

A study of the male genitalia of the lectotype shows them to be identical to those of *pallidella*, and Meyrick's name falls as a synonym.

My concept of *sciadopa*, based solely on Meyrick's description, led me to place the species in the *ciniflonella* group of *Martyrhilda*. Meyrick's species is not referable to *Martyrhilda*, but the species described and figured by me is referable to *Martyrhilda* and requires a name. In the following pages the proper correction is made and a new name supplied.

Agonopterix sabulella (Walsingham)

In addition to the specimens discussed in my revision I now have before me a series of nine specimens from King Mountain, San Mateo County, Calif. (May and July dates, W. Harry Lange), reared from *Eriophyllum confertiflorum* Gray, and a male and female from Chuckanut Bay, Bellingham, Whatcom County, Wash. (13-14-VI-46, J. F. G. Clarke), reared from *Eriophyllum lanatum* (Pursh) Forbes.

The Washington specimens are considerably darker than the California examples, but there is no doubt as to their identity.

Larva: Length 13–16 mm, subcylindrical. Head luteous with irregular light brown markings, darker around margins; ocellar area dark brown to black. Cervical shield and anal plate yellowish, the former with a few dark brown

markings on lateral and posterior margins. Thoracic and abdominal segments yellowish green with three gray-green dorsal longitudinal stripes. Thoracic legs yellowish. Spiracles small, black.

The larvae are abundant and together with *Nephopteryx olivalis* Packard, nearly strip the host of its leaves. Young larvae of *sabulella* are found in the terminal leaves and buds of the host, the older ones in the lateral leaves which they tie to the stalk of the plant.

The food plant grows on the rocky slopes and beside the railroad tracks around the seashore of Chuckanut Bay, south of Bellingham.

Agonopterix dammersi, n. sp.
Figs. 1–1a, 8

Similar to *sabulella* but grayer in appearance.

Labial palpus with second segment cream color interiorly, more ocherous exteriorly; brush trumpet-shaped, developed only in terminal half, irrorate with black and suffused with fuscous; third segment more ocherous with subbasal, supramedial, and terminal bands black. Antenna fuscous. Face ocherous-white. Head, thorax, tegula, and forewing light grayish ocherous; thorax sparsely irrorate with black scales; forewing irrorate with black and with irregular patches of underlying gray suffusion, especially toward termen; at basal third and at end of cell two usually ill-defined, small, black discal spots; between these, costad, a moderately large dark shade; along costa and around termen a series of small black spots; cilia mottled; on the underside of forewing, along costa, and around termen, black irrorations. Hind wing fuscous; cilia light grayish fuscous with darker subbasal and subterminal bands; on the underside of hind wing, on costa and around termen, black irrorations. Legs cream color; first and second pairs strongly overlaid with blackish fuscous; third pair suffused and irrorate with fuscous. Abdomen light grayish ocherous above, cream color, with four rows of black spots, beneath.

Male genitalia.—Harpe moderately broad, sacculus rather narrow; cucullus rounded; clasper nearly straight, digitate. Anellus longer than broad, expanded laterally posterior to middle, sharply convex on anterior edge, with small lateral lobes. Aedeagus slightly bent; vesica with a small, finely spinulate, elongate patch. Vinculum rounded, with large dorsoanterior process. Transtilla a narrow sclerotized band with large lateral lobes. Socii very large, compressed.

Female genitalia.—Genital plate rather lightly sclerotized, broad, strongly convex on anterior edge at middle. Ostium large, at center of genital plate. Ductus bursae entirely membranous gradually tapering into the small bursa copulatrix; inception of ductus seminalis just before ostium. Signum a small, toothed plate at extreme anterior end of bursa copulatrix.

Alar expanse, 20–23 mm.

Type.—U.S.N.M. no. 58012.

Type locality.—Forest Home, San Bernardino County, Calif.

Food plant.—*Senecio douglasii* D. C.

Remarks.—Described from the ♂ type, two ♂ and four ♀ paratypes, collected and reared by Commander C. M. Dammers. One ♀ paratype is from Riverside, Calif. (April 24, 1938), the remainder are from the type locality and bear dates from June 13 to 16, 1940.

Paratypes in U. S. National Museum and Commander Dammers' collection.

This species can be distinguished from *sabulella* by its grayer color and by the slender terminal segment of the palpus with its three black bands; the terminal segment of the palpus of *sabulella* never has more than two ill-defined bands.

The clasper of the harpe of *sabulella* has a distinct terminal knob, while that of *dammersi* is straight, digitate, and lacks the knob. The lobes of the ovipositor of *dammersi* have more setae than those of *sabulella*, and the ostium is at the center of the genital plate in *dammersi* but at the posterior edge in *sabulella*.

In the color key of my revision *dammersi* runs to *fusciterminella*, but can be distinguished from that species by the complete absence of any reddish coloring.

Named in honor of Commander Dammers who has been a friendly contributor to the National Collection for many years.

Agonopterix latipalpella Barnes and Busck

In addition to the type series I now have a series of one ♂ and three ♀ ♀ from San Benito and Brownsville, Tex. These bear April dates.

Agonopterix murmurans (Meyrick)

Depressaria murmurans Meyrick, *Exotic Microlepidoptera* **3**: 382. 1927.—Clarke, Proc. U. S. Nat. Mus. **90**: 39. 1941.

This species has genitalia similar to *psoraliella* but is of quite different appearance. Until the species is reared or intergrades between this and *psoraliella* are found I am retaining *murmurans* as a distinct species.

In the U. S. National Collection there are three specimens as follows: Utah: Eureka, ♂ (VII-1-11, Tom Spalding); Stockton, ♀ (no date, Tom Spalding). Washington: Pullman, ♀ (1-X-32, J. F. G. Clarke).

Agonopterix robiniella (Packard)

To the localities previously recorded for this species a single record for New Mexico (♂, Jemez Springs, July) may now be added.

Agonopterix posticella (Walsingham)

This species has not been recorded before north of Oregon. We now have a series of two ♂♂ and three ♀♀ from Chimacum, Kitsap County, Wash. (August 2, 1944), reared from *Psoralea physodes* Dougl.

The Washington specimens are considerably darker than the California and Oregon examples, but there is no doubt about their identity.

Martyrhilda canella (Busck)

In Fig. 44, I figured the wing venation of this species incorrectly. The figure of the hind wing shows only seven veins and should show eight. In the generic diagnosis eight veins are correctly indicated.

Martyrhilda thoracenigraeella (Chambers)

An additional four specimens (three ♂♂, ♀) of this species have come to hand. These were collected by E. C. Johnston at Petaluma, Calif. (2-20-X-1936).

Martyrhilda thoracefasciella (Chambers)

A large series of this species, which has accumulated, indicates it is widespread through California and Arizona. In addition we have one specimen from Pyramid Lake, Nev. (♀, no date or collector).

Martyrhilda isa, n. sp.

Martyrhilda sciadopa Clarke (*not* Meyrick), Proc. U. S. Nat. Mus. **90**: 144, pl. 24, fig. 149, 149a; pl. 41, fig. 236. 1941.

Type.—U.S.N.M. No. 58014.

Type locality.—Aweme, Manitoba.

Food plant.—Unknown.

Remarks.—Under the name *sciadopa* I discussed and figured this species. In the foregoing pages Meyrick's name is discussed under *Agonopterix pallidella* (Busck).

The paratypes consist of the specimens listed in my revision plus the following: Alberta: Edmonton, four ♂♂, six ♀♀ (March, April, and May, Owen Bryant); Manitoba: Aweme, ♀ (21-III-05, Criddle); Cartwright, ♂ (1-IV-05, E. F. Heath); Ontario: Hymers, six ♂♂, two ♀♀ (August and September). Paratypes in the U. S. National and British Museums.

Depressaria artemisiella McDunnough

Heretofore recorded only from the type locality in British Columbia. There is one specimen in the U. S. National Museum from Deer Creek, Provo Canyon, Utah (♂, 8-IX-18, Tom Spalding).

Depressaria artemisiae dracunculi Clarke

The range of this subspecies is now extended to Manitoba. Specimens submitted are from Aweme (♂, 9-IX-28; ♀, 2-VIII-20. N. Criddle).

Depressaria alienella Busck

Depressaria alienella Busck, Proc. U. S. Nat. Mus. **27**: 765. 1904.

Depressaria nymphidia Meyrick, *Exotic Microlepidoptera* **2**: 223. 1918. (New synonymy.)

Depressaria corystopa Meyrick, *Exotic Microlepidoptera* **3**: 382. 1927. (New synonymy.)

The types of both of Meyrick's species are in the British Museum.

I have seen the types and have examined the genitalia of both. The moths agree with specimens in the U. S. National Museum from widespread localities in North America and the genitalia match perfectly. Meyrick's names therefore fall as synonyms of *alienella.*

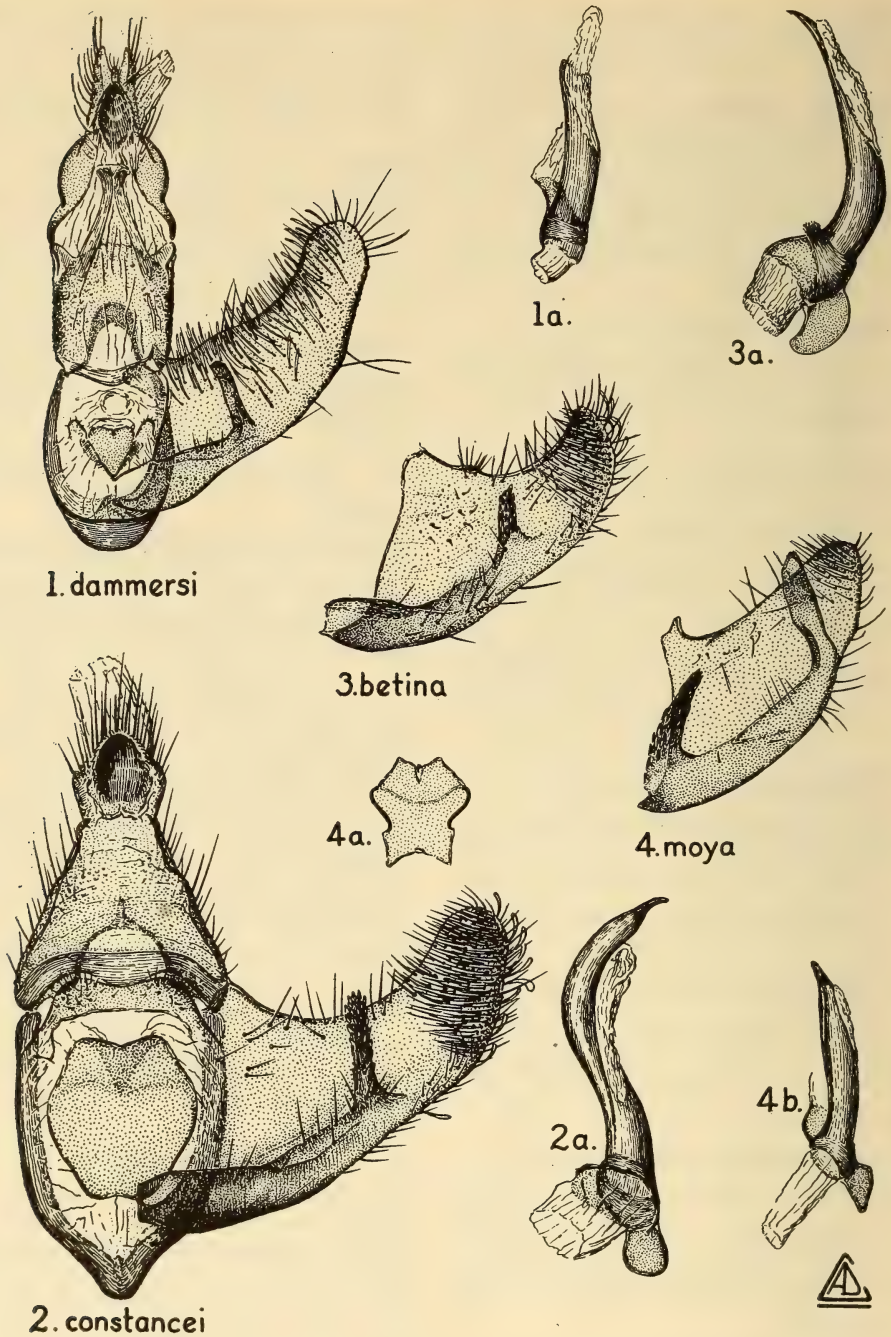
Type localities.—Kaslo, British Columbia, Canada (*alienella*); Colorado (*nymphidia*); Toronto, Ontario, Canada (*corystopa*).

The widely separated type localities only emphasize the great range of this species. In addition to the localities given in my revision there are now specimens from the following localities: Arizona: White Mountains (♂, August 1925, O. C. Poling); Connecticut: East River (♀, July, Charles R. Ely).

Depressaria constancei, n. sp.

Figs. 2–2a, 9–9a

This is the largest species of *Depressaria* I have seen from North America and resembles only the following newly described species.



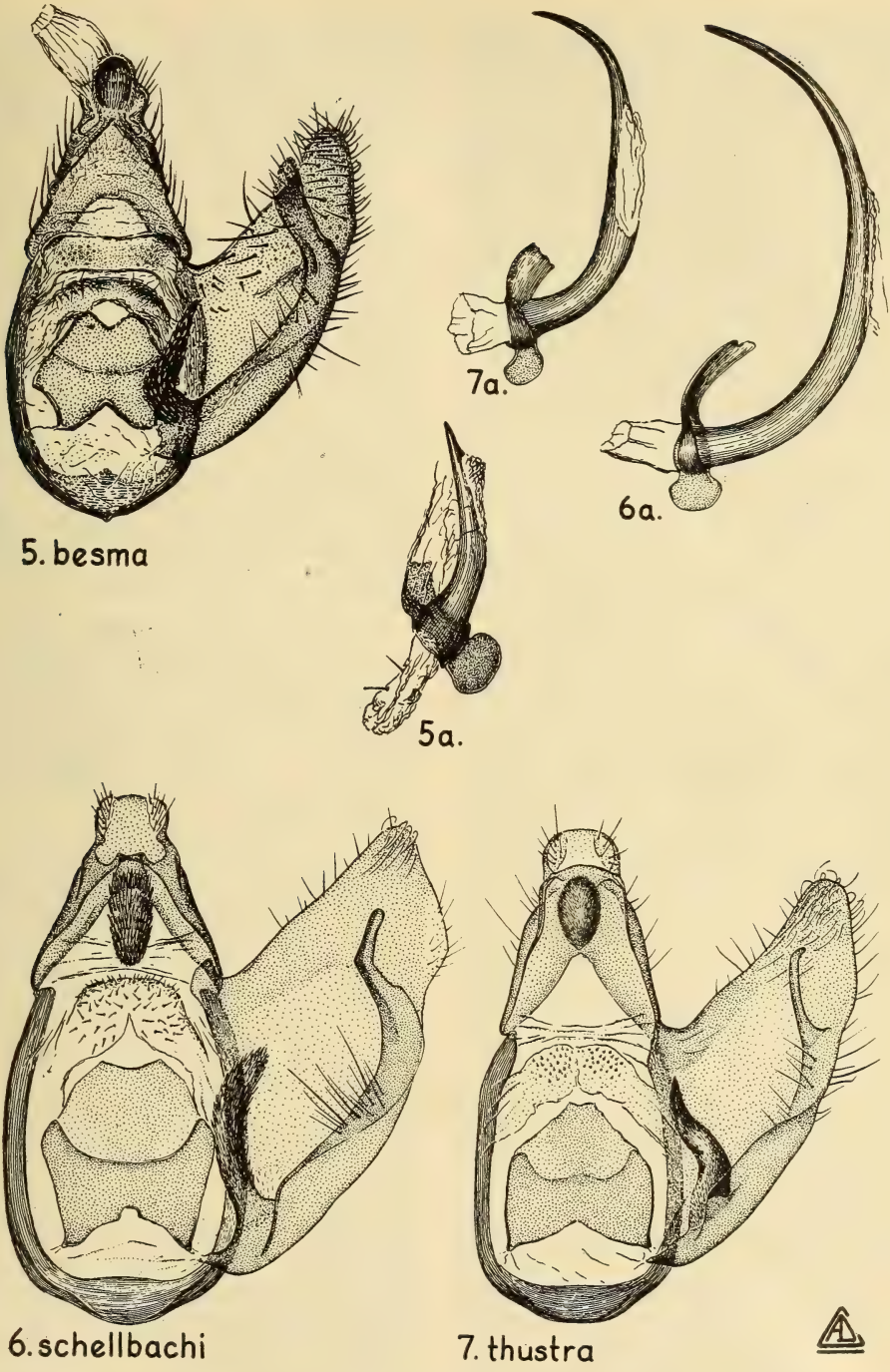
FIGS. 1–4.—Male Genitalia

1–1a. *Agonopterix dammersi*, new species: 1, Ventral aspect of male genitalia with left harpe and aedeagus removed; 1a, aedeagus, lateral view.

2–2a. *Depressaria constancei*, new species: 2, Ventral aspect of male genitalia with left harpe and aedeagus removed; 2a, aedeagus, ventrolateral view to show twist.

3–3a. *Depressaria betina*, new species: 3, Ventral aspect of right harpe; 3a, aedeagus, lateral view.

4–4b. *Depressaria moya*, new species: 4, Ventral view of right harpe; 4a, ventral aspect of anellus: 4b, aedeagus, lateral view.



FIGS. 5–7.—Male Genitalia

5–5a. *Depressaria besma*, new species: 5, Ventral aspect with left harpe and aedeagus removed; 5a, aedeagus, lateral view.

6–6a. *Depressaria schellbachi*, new species: 6, Ventral aspect with left harpe and aedeagus removed; 6a, aedeagus, lateral view.

7–7a. *Depressaria thustra*, new species: 7, Ventral aspect with left harpe and aedeagus removed; 7a, aedeagus, lateral view.

Labial palpus with second segment whitish ocherous, brush suffused with reddish fuscous; near base a fuscous band exteriorly; third segment fuscous strongly suffused with red; tip reddish ocherous. Antenna fuscous strongly suffused with red basally. Head fuscous, the scales tipped with cinereous. Thorax reddish fuscous anteriorly shading to gray posteriorly. Tegula dark reddish fuscous basally shading to gray posteriorly. Forewing purplish fuscous, heavily overlaid with red so that the wing presents a rich brown-red appearance, and irrorate and streaked with gray scales; inner angle narrowly black shading to reddish fuscous; at end of cell a pale gray discal spot preceded by a narrow fuscous streak and followed by a few fuscous scales. In some specimens the spot and streak are obsolete. At outer third there is a more or less distinct outwardly curved gray line; cilia fuscous tinged with reddish. Hind wing fuscous, lighter basally; cilia yellowish fuscous with dark basal and subterminal bands; beyond *1b* suffused with reddish. Costa of both fore- and hind wings edged with yellowish beneath and whole underside with abundant fuscous scaling. Abdomen silvery fuscous above, cream color overlaid with fuscous beneath. Legs with cream-colored femora overlaid with fuscous; first and second pairs with tibia suffused with pink and tarsi fuscous with pink annulations; tibia of third leg with numerous yellowish hairlike scales; tarsi fuscous annulated with yellowish.

Male genitalia.—Harpe much narrower beyond clasper than at base; cucullus rounded; clasper straight, slightly exceeding costa, roughened by many minute, blunt spines; sacculus narrow. Anellus longer than broad, broader at middle than at ends; proximal end slightly concave, distal end strongly so; lateral lobes absent. Vinculum slightly produced into a bluntly pointed process. Aedeagus moderately sclerotized, sharply pointed and twisted so much so that the distal end cannot be shown adequately due to foreshortening. Gnathos normal, an oval spined knob. Transtilla a moderately sclerotized band, anterior edge somewhat produced at middle and shallowly excavate on each side; transtillar lobes well developed. Uncus and socii forming a small hood.

Female genitalia.—Genital plate narrowed and strongly sclerotized at ostium; ostium triangular. Ductus bursae with a broad crescentic, lightly sclerotized section before ostium, remainder membranous and spiraled; ductus seminalis on right side just before ostium. Bursa copulatrix large, oval; signum a small, narrow, toothed plate.

Alar expanse, 24–27 mm.

Type.—U.S.N.M. no. 58007.

Type locality.—Yreka, Siskiyou County, Calif.

Food plant.—Lomatium californicum (Nutt.) Math. & Const.

Remarks.—Described from the ♂ type, 12 ♂ and 13 ♀ paratypes from Yreka (21-V to 2-VI-46, J. F. G. Clarke), four ♀ paratypes from Kelseyville, (19-IV to 25-VII-1944, W. Harry Lange) and 1 ♂ from Pacheco Pass, Calif. (16-IV-1939, W. Harry Lange). All the Yreka specimens were reared from larvae collected by the author. Paratypes in the U. S. National and British Museums and W. Harry Lange Collection.

The larvae, from which the Yreka moths were obtained, were collected on plants growing along the east side of U. S. Highway 99, about 6 miles north of Yreka. The food plant grows abundantly on the rocky hillsides and in the canyons in this region and farther north in southern Oregon.

The larva is as follows: Length 17–18 mm. Head testaceous, strongly marked with dark brown laterally. Thoracic shield pale greenish brown broadly edged with black. Thoracic legs pale yellowish. Thoracic and abdominal segments concolorous, light gray-green above, pale yellowish green beneath. Spiracles narrowly edged with dark brown. Tubercles pale whitish green; setae brown. Anal plate light gray green finely irrorate with brown. In the early instars the head and thoracic shield are black.

The habits of this species are similar to many other species of *Depressaria*, the larvae being gregarious in the first instars and then spreading to the leaves of the plants. In the later stages the larvae are leaf rollers. New rolls are made from time to time to accommodate the growing larva.

Larvae and pupae are preserved in the U. S. National Museum.

This species keys to *juliella*, but is at once distinguished from it by the deep brown-red color.

This species is named in honor of my good

friend Lincoln Constance, of the Department of Botany, University of California, who has made all the determinations of the Umbelliferae for me and whose keen interest and enthusiasm have been a constant source of encouragement.

This and the following species, although *Lomatium* feeders, present a departure from the usual species (*angustati-multifidae* complex) feeding on these plants, both in coloration and male genitalia. The female genitalia retain the features of the other species and the larvae, like those of *angustati*, etc., have setal group VII on the first abdominal segment *tri*setose.

Both *betina* and *constancei* are reddish brown in general appearance, though amply distinct from each other, whereas the other species (*angustati*, *multifidae*, etc.) are dark fuscous in general coloration.

The male genitalia of *betina* and *constancei* lack the large, spinous process from the sacculus and the aedeagus is atypical.

The above characteristics seem to indicate that *betina* and *constancei* are transitional between the *juliella-heracliana* group and that containing *angustati-multifidae*.

Depressaria betina, n. sp.
Figs. 3–3a, 10

Strikingly similar to the foregoing species but smaller and more contrastingly marked.

Labial palpus with second segment creamy white with reddish-brown and fuscous scales mixed in the brush; exteriorly basal third broadly banded with blackish to reddish fuscous; at apical third an indication of a narrower similarly colored band; third segment blackish fuscous, with tip reddish ocherous. Antenna dark reddish fuscous narrowly annulated with reddish ocherous. Head and thorax cinereous, the former mixed with some fuscous scaling, the latter reddish fuscous anteriorly; tegula concolorous with thorax. Forewing dull grayish fuscous strongly overlaid with reddish fuscous scales and with the veins indicated by black streaks; anal angle narrowly black, shading outwardly to the ground color of the wing; discal spot at end of cell usually well defined, preceded by a streak of mixed gray and black scales and followed by a black streak; on costa, about middle, a small fuscous spot; at outer third an outwardly curved gray line; cilia fuscous with reddish suffusion. Hind wing grayish fuscous, darker at margins; cilia light fuscous with darker basal and subterminal bands; beyond *1b* the cilia are narrowly tipped with pink. Undersides of fore- and hind wings dark fuscous; costa of forewing pale yellowish and that of hind wing creamy white. Abdomen silvery fuscous above, cream-colored, irrorate and suffused with fuscous, beneath. Legs creamy white overlaid with fuscous. Fore- and mid-tibiae and tarsi tinged with pink; hind tarsi annulated with pale reddish ocherous.

Male genitalia.—Similar to *constancei* but clasper not reaching costa, anellus nearly as broad as long and vinculum more broadly rounded.

Female genitalia.—Similar to *constancei* but the signum three times the size of *constancei* and with anterior and posterior points well developed.

Alar expanse, 19–23 mm.

Type.—U.S.N.M. no. 58008.

Type locality.—Gilmer, Klickitat County, Wash.

Food plants.—*Lomatium triternatum macrocarpum* (Coult. & Rose) Mathias, *L. dissectum* (Nutt.) Math. & Const., *L. columbianum* Math. & Const.

Remarks.—Described from the ♂ type, 18 ♂ and 11 ♀ paratypes as follows: Gilmer (type, 13 ♂♂ and eight ♀♀, 30-V to 10-VI-46); Husum (♀, 30-V-46); Lyle (five ♂♂ and two ♀♀, 5-10-VI-46). All localities are in Klickitat County, Wash., and all specimens were reared from larvae collected by the author.

L. triternatum macrocarpum was found on a steep open hillside growing in a *Rhus toxicodendron-Balsamorhiza sagittata* association and below this area, a mile east of Gilmer, on open, rocky rolling ground in which *Quercus* and *Salix* were the dominant plants. *L. dissectum* may be found growing among the brush on the roadside at Husum. *L. columbianum* grows above the Columbia River on the steep, rocky slopes. The collections from this plant were made 1 mile west of Lyle between the highway and the river.

Feeding of the larvae appears to be limited to the umbels and leaves, depending on the host. *L. dissectum* and *L. triternatum* usually have the umbels attacked but, since *L. columbianum* is in fruit at the time the larva of this species appears, the feeding takes place in the webbed leaves.

The larvae of this species and *D. constancei* are, like the adults, strikingly similar. The dark markings of the head and thoracic shield are more intense in *betina* than in *constancei*. The larvae of *constancei* average larger, and three, rather indistinct, dorsal longitudinal lines of *betina* are lacking in this species.

Larvae and pupae are preserved in the U. S. National Museum.

With *constancei* this species keys to *juliella* in the color key but like *constancei* is distinguished from that species by the much darker color. The grayish fuscous ground color of *betina* will separate it from *constancei*.

Depressaria schellbachi, n. sp.
Figs. 6–6a, 13

Labial palpus ocherous white with a pink tinge; second segment irrorate with pink-tipped fuscous scales in the brush and with an indistinct fuscous spot subbasally and apically on the outside; third segment blackish fuscous, tip reddish ocherous. Antenna blackish fuscous with ill-defined narrow lighter annulations. Head reddish ocherous to reddish fuscous. Thorax and ground color of forewing reddish ocherous; anterior part of thorax and base of tegula blackish fuscous gradually shading to the lighter ground color. Forewing overlaid with fuscous; inner angle black shading to fuscous outwardly; in cell two, sometimes confluent, black longitudinal dashes; in fold, at basal third, a short black dash; veins 9, 10, and 11 sometimes marked by fine, black, longitudinal dashes; in center of wing at end of cell, a small reddish ocherous spot; cilia pale fuscous with a roseate tinge; underside of costa narrowly, but clearly, reddish ocherous. Hind wing whitish basally shading to dark fuscous at margins; cilia pale fuscous with a broad fuscous subbasal band and with a roseate tinge, especially apically. Legs ocherous-white overlaid and irrorate with fuscous; tarsi with reddish-ocherous annuli. Abdomen light fuscous; underside with considerable median ocherous-white scaling.

Male genitalia.—Harpe broad basally, abruptly narrowed to the bluntly pointed cucullus; costa almost straight, clasper narrow, transverse to middle, then sharply and outwardly angulate; basal process from sacculus narrow and almost of equal width throughout, slightly longer than anellus, gently excurved and finely spinulate. Anellus as broad as long; anterior edge deeply excavate; lateral edges convex. Aedeagus two and a half times as long as costa of harpe, slender, evenly curved, sharply pointed; ventrobasal process large, shovel-shaped, outer edge emarginate; dorsobasal process small, winglike. Transtilla very lightly sclerotized, lobes mainly indicated by small setae. Gnathos elongate oval. Uncus and socii greatly reduced.

Female genitalia.—Genital plate narrow, posterior edge emarginate; ostium slitlike; anterior sclerotized pockets of genital plate small, shallow. Ductus bursae with more than half its length strongly sclerotized, this portion crescentic; inception of ductus seminalis well before ostium. Signum a large oval toothed plate.

Alar expanse, 21–24 mm.

Type.—U.S.N.M. No. 58013.

Type locality.—Shoshone Point, Grand Canyon, Ariz., elevation 7,050 feet.

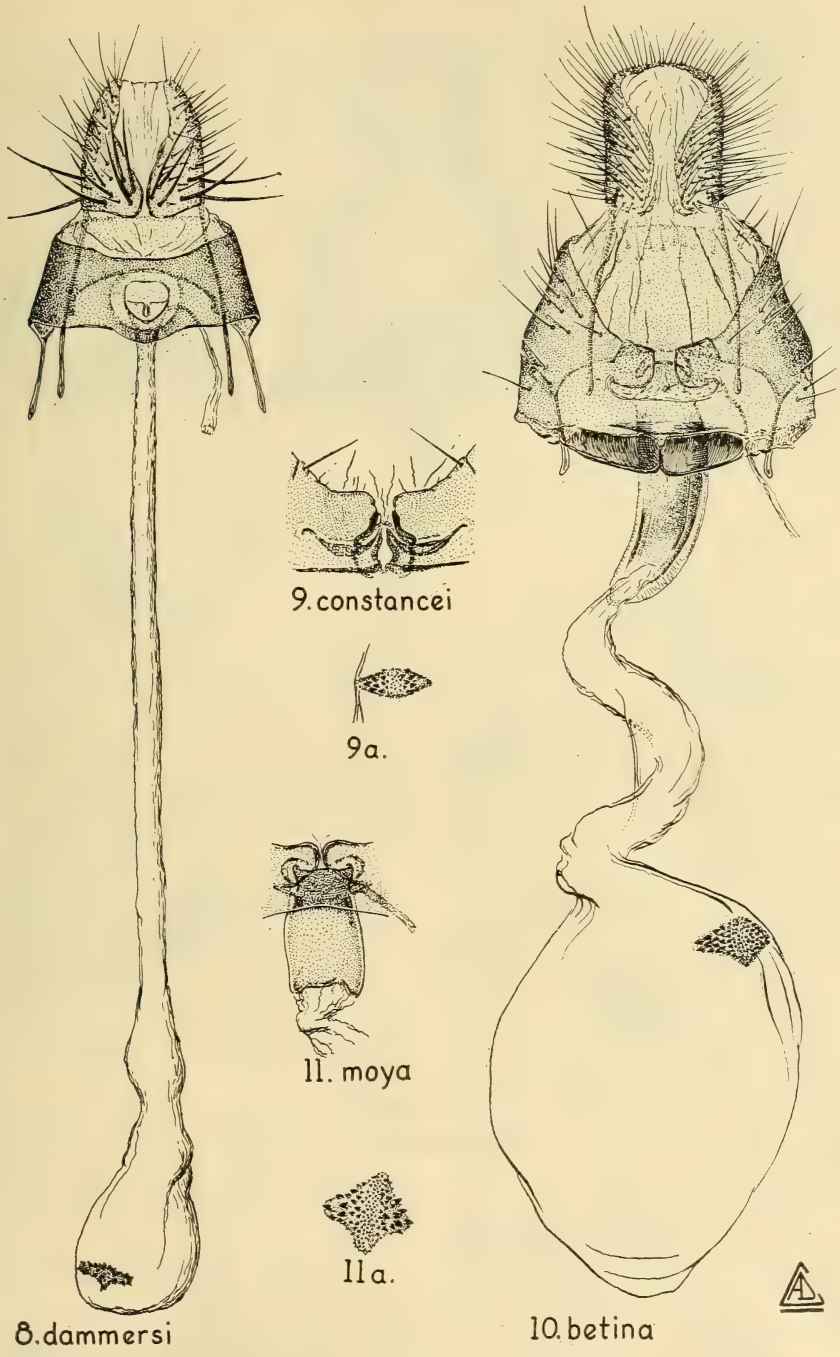
Food plant.—Lomatium macdougali Coult. and Rose.

Remarks.—Described from the ♂ type, five ♂ and three ♀ paratypes from the Grand Canyon (June dates, 1944 and 1946, Louis Schellbach, 3d). Paratypes in the U. S. National and British Museums and in the Grand Canyon National Park Collection.

In genitalia *schellbachi* is nearest to *whitmani*. It differs from the latter species in having a longer basal process from the sacculus and a longer anellus. In the female, *schellbachi* lacks the pronounced anterior and posterior median points of the signum and the posterior edge of the genital plate is emarginate. From other species of *Depressaria* in this complex *schellbachi* differs by its pronounced reddish coloration.

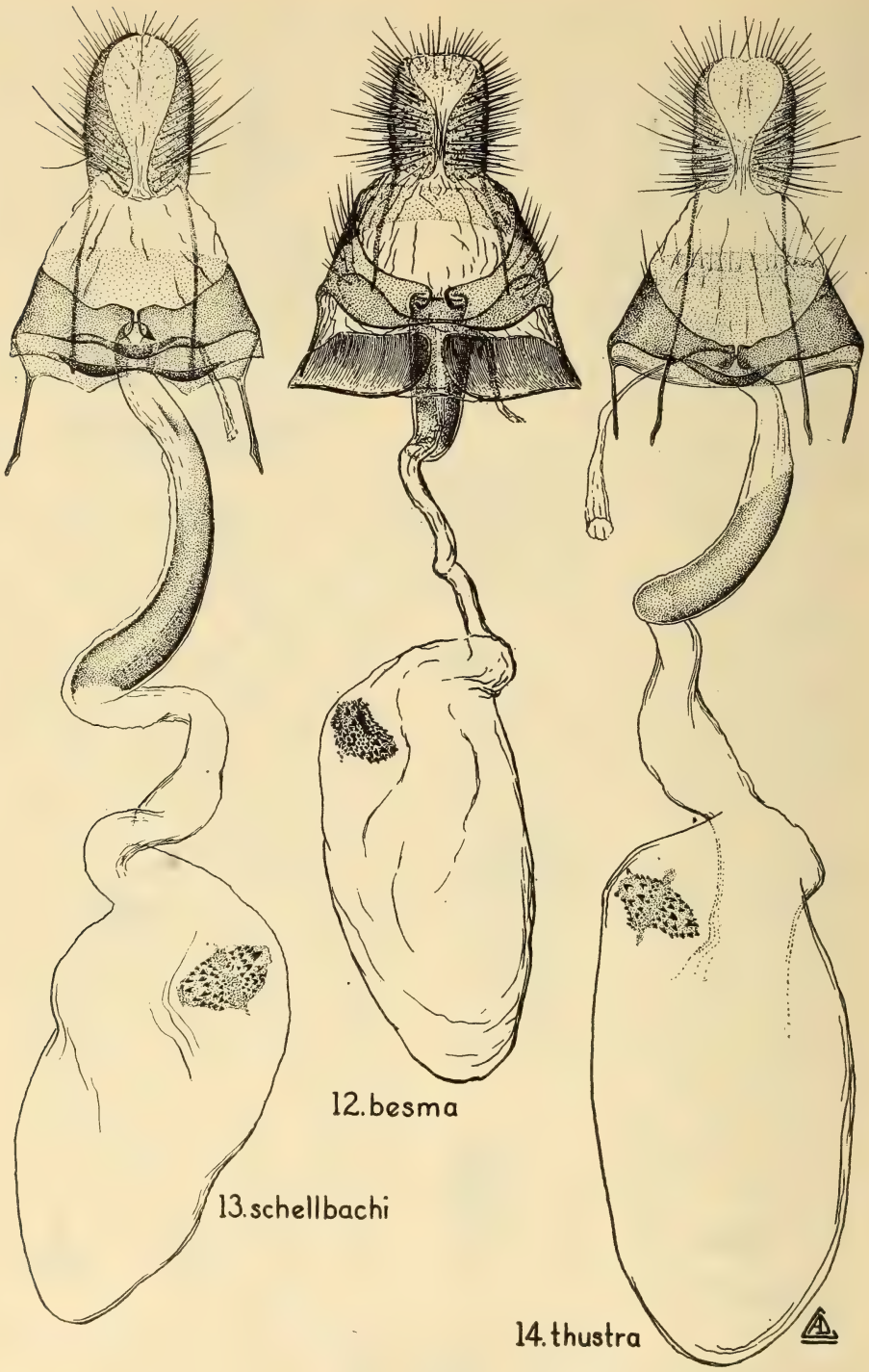
All the specimens of the type series were reared from larvae collected by Louis Schellbach, 3d, park naturalist of Grand Canyon National Park. His notes on the larvae, with my additions in brackets are reproduced below. It will be noted that the feeding of the *schellbachi* larvae is confined to the leaves.

"On May 28, 1944, two small green larvae, with black heads, were found on the above plant [*Lomatium macdougali*], deep down in the leaf stem sheaths of the plant. Attention to the plant was due to a cobwebby appearance about the base of the leaves where they leave the main stem or root. The plant was found



FIGS. 8–11.—Female Genitalia

8. *Agonopterix dammersi*, new species: Ventral view.
9–9a. *Depressaria constancei*, new species: 9, Ventral aspect of genital plate to show ostium; 9a, signum.
10. *Depressaria betina*, new species: Ventral view.
11–11a. *Depressaria moya*, new species: 11, Ventral view of ostium and sclerotized portion of ductus bursae; 11a, signum.



FIGS. 12–14.—Female Genitalia

12. *Depressaria besma*, new species: Ventral aspect.
13. *Depressaria schellbachi*, new species: Ventral aspect.
14. *Depressaria thustra*, new species: Ventral aspect.

growing at Shoshone Point (elevation 7,050 feet) on the South Rim of Grand Canyon. The plant was collected with the larvae and placed in a rearing jar. During the next few days several others were found and brought in to the workshop.

"Eleven (11) in all were collected and seemed to be in a more advanced stage than those reared from the flower head collected on May 9, 1944 [*Sparganothis* sp.]

"With the knowledge gained in observing the specimens from the May 9 larvae, it was found that this group of larvae, collected feeding on the leaves, would not touch the flower heads when offered them. Yet both groups of larvae were found on the same species of plants.

"On June 3, 1944, all larvae had entered the pupal stage and it was noted that the pupae cases were of a brown color, not black like those feeding on the flowers of the previous group [*Sparganothis* sp.].

"June 18, 1944, two moths emerged. They, too, were different in color from the previous group. They were a dark chocolate brown instead of a light straw color.

"June 22, 1944, four more moths emerged.

"July 2, 1944, all moths had emerged. Of the eleven larvae collected, only seven (7) were reared to parenthood."

The range of the host plant, as given by Mathias and Constance,[3] is "Great Basin, from Western Wyoming to central Oregon, south to central Arizona."

Although this oecophorid is recorded only from the Grand Canyon we may expect to find it anywhere within the range given for the food plant.

On coloration *schellbachi* will key to the *whitmani-leptotaeniae* complex, but can be distinguished from both those species by the greater extent of the reddish ocherous coloration of the forewing.

Depressaria multifidae Clarke

Formerly[4] I recorded the food plant of this species as *Lomatium grayi* Coult. & Rose and discussed how the larvae had been given substitute food and had refused it. The larvae of this species do feed on at least one other species of the plants of this genus. On May 9, 1946, I collected a considerable number of larvae feeding in the leaves of *Lomatium columbianum* Math. & Const., 1 mile west of Lyle, Klickitat County, Wash. From these larvae I obtained one ♂ and 12 ♀ ♀, the genitalia of which show no differences from those of *multifidae*.

Presumably the larvae usually pupate in debris or in the soil at the base of the host, but one pupa, from which a moth was obtained, was found in a hollow peduncle. There was evidence in this and other stalks of extensive feeding within, and several were found with exit holes cut in the apex between the rays of the umbels.

The moths emerged in the last week of May and the first week in June.

Depressaria moya, n. sp.
Figs. 4–4b, 11–11a

A medium-sized, dark-colored moth with a smooth, shiny appearance.

Labial palpus with second segment buff colored with fuscous shading exteriorly and in the brush; third segment blackish fuscous tipped with light ocherous. Head, thorax, and basal patch on costa of forewing, ocherous; head and thorax with some fuscous scales. Antenna blackish fuscous faintly annulated with paler fuscous. Forewing fuscous shading to blackish fuscous basally; outer discal spot light ocherous preceded by a streak of blackish fuscous and ocherous scales mixed; between this streak and costa an ill-defined ocherous patch; cilia pale fuscous with darker subbasal band. Hind wing light grayish fuscous, slightly darker toward margins; cilia light fuscous with dark subbasal band. Legs buff colored overlaid and suffused with fuscous. Abdomen shining grayish fuscous above, buff suffused with fuscous beneath.

Male genitalia.—Harpe moderately broad, cucullus bluntly pointed; clasper exceeding costa, flattened distally, bluntly pointed, broadened at middle, constricted basally; basal process from sacculus moderately stout, tapering to a sharp point, gently excurved. Anellus longer than broad, the broadest part being posterior of the middle, on each side there is a small excavation and the anterior and posterior edges are concave, the former more so than the latter. Aedeagus short, curved, pointed with a roughly rectangular dorsal process and a

[3] MATHIAS, MILDRED E., and CONSTANCE, LINCOLN. North Amer. Flora **28B**, pt. 2: 240. 1940.

[4] Proc. U. S. Nat. Mus. **90**: 187. 1941.

shovel-shaped ventral process at base. Vinculum narrow, slightly evaginate anteriorly. Transtilla a narrow, lightly sclerotized band with well-developed lobes. Socii small, mainly indicated by a few hairs.

Female genitalia. — Genital plate broad, strongly sclerotized, anterior edge shallowly concave. Ostium narrow with small raised portion of genital plate, on each side, fused with the ductus bursae. Posterior third of ductus bursae sclerotized, gently tapered to membranous anterior section; inception of ductus seminalis from well before ostium on right side. Signum a large square toothed plate.

Alar expanse, 18–19 mm.

Type.—U.S.N.M. no. 58011.

Type locality.—Hornbrook, Siskiyou County, Calif.

Food plant.—*Lomatium vaginatum* Coult. & Rose.

Remarks.—Described from the ♂ type and 2 ♀ paratypes all from the type locality.

The larvae of this species were collected April 7, 1944, by the author. The first larva entered the soil in the rearing tin on April 12, pupated on the 14th, and the moth emerged on May 5, 1944.

The host, on which these larvae were found, was growing abundantly on a grassy hillside along the east side of U. S. Highway 99 about 1 mile south of the Oregon-California line. The plant may be found commonly well into southern Oregon, and no doubt this *Depressaria* will be found there also.

The larva is as follows: Length 10–12 mm. Head and thoracic shield pale whitish green suffused with pale yellowish brown and variously spotted with brown to black, especially laterally. Thoracic legs pale yellowish with a brown spot at the distal end of each segment exteriorly. Thoracic and abdominal segments concolorous light gray-green above and whitish green below; last segment entirely whitish green, this color extending forward onto the next segment forming a short subdorsal stripe on each side. Anal plate yellowish. Spiracles narrowly edged with dark brown. Tubercles, except center, pale whitish green; center and setae dark brown. Setal group VII of the first abdominal segment is *tri*setose.

Larvae and pupae preserved in the U. S. National Museum.

This species keys to *angustati-multifidae* from which there are no reliable color characters for separation. Locality and food plant will serve to separate *moya* from the above two or, if dissections can be made, the genitalia will establish the identity. In *moya* the clasper extends beyond the costa of harpe but in the other two the clasper is much shorter. In the females of *angustati* and *multifidae* the sclerotized part of the ductus bursae is separated from the ostium by a section of membrane, but in *moya* the ostium and sclerotized part are contiguous.

Depressaria besma, n. sp.

Figs. 5–5a, 12

Labial palpus, head, and thorax light buff; second segment of palpus with fuscous and brown scales mixed in the brush; third segment blackish fuscous except for tip which is buff; thorax with blackish fuscous and pale brown scales mixed anteriorly. Antenna blackish fuscous, with narrow, pale buff annulations. Forewing fuscous, almost black basally; at end of cell a well-defined pale buff spot followed by a few black scales and preceded by a more or less well-defined black line; veins 9, 10, and 11 indicated by black scaling; around apex and termen a series of black spots at the ends of the veins usually preceded by a few pale buff scales; costa pink tinged; cilia light fuscous with a dark subbasal band. Hind wing light grayish fuscous, darker outwardly; cilia sordid buff with a fuscous subbasal band. Legs, except second and third pairs of tarsi, pale buff suffused with fuscous; tarsi blackish fuscous, buff annulated. Abdomen shining grayish above, pale buff below, broadly shaded with grayish laterally.

Male genitalia.—Harpe broard and short; cucullus bluntly pointed; clasper exceeding costa, flattened, excurved, bluntly pointed; basal process from sacculus slender, pointed and sharply outwardly angulate from slightly beyond base. Anellus broader than long, roughly diamond-shaped; anterior and posterior edges with deep V-shaped excavations. Aedeagus short, stout, curved, gently tapered to a point; base with large winglike structure dorsally and broad shovel-shaped ventral process. Transtilla a narrow, lightly sclerotized band with moderately well-developed lobes. Vinculum narrow, broader at middle, rounded. Socii very small.

Female genitalia.—Genital plate strongly sclerotized; anterior edge shallowly concave. Ostium narrow with a raised portion of the genital plate, on each side, fused with the ductus bursae. Ductus bursae strongly sclerotized posteriorly for about one-third of its length, this part swollen at middle; inception of ductus seminalis well before ostium from a small, membranous evagination on the right side of the ductus bursae. Signum a large oval, toothed plate.

Alar expanse, 17–20 mm.

Type.—U.S.N.M. no. 58010.

Type locality.—Fort Lewis, Pierce County, Wash.

Food plant.—*Lomatium utriculatum* (Nutt.) Coult. & Rose.

Remarks.—Described from the ♂ type and one ♂ and one ♀ paratypes, all from the type locality.

The larvae, from which the type series was reared, were collected April 30, 1944, by the author. At this time the larvae were nearly full fed and entered the soil within a few days after being collected. The first larva pupated May 5, but this specimen died. The moths emerged May 29 and 30, 1944.

The host plants on which these specimens were collected were growing on the prairie, 6 miles east of the main gate of Fort Lewis, in an oak–fir–Scotch broom association.

The larvae of this and the foregoing species are almost identical, but those of *besma* may be distinguished from larvae of *moya* by the absence of any brown coloring on the lateral edges of the thoracic shield.

The moths are immediately distinguishable by several characters: The thorax of *besma* is buff colored and that of *moya* ocherous. The outer discal spot of *moya* is ocherous and there is no pink tinge along the costa as in *besma.*

In the male genitalia the anellus of *besma* is broader than long, but that of *moya* is longer than broad. The most conspicuous difference between the two, however, is found in the basal process of the sacculus which is sharply angulate in *besma* and gently excurved in *moya.* In the females the signum of *moya* is large and square, that of *besma* is oval.

Larvae preserved in the U. S. National Museum.

Like the foregoing species *besma* keys to the same place in the color key, and can be separated from *angustati* and *multifidae* in the same manner. The separation of *moya* and *besma* is discussed above. The genitalia of *besma* differ from those of *angustati* and *multifidae* in the same manner as do those of *moya.*

Depressaria thustra, n. sp.

Figs. 7–7a, 14

A medium-sized dark species nearest *togata* Walsingham.

Labial palpus with second segment ocherous-white speckled exteriorly with black and suffused with purplish fuscous in the brush; third segment blackish fuscous except the tip which is pale ocherous. Head ocherous-brown, the scales whitish tipped; face buff. Thorax and tegula ocherous shaded with blackish fuscous anteriorly. Forewing blackish fuscous with scattered ocherous scaling, especially along costa; base of wing black, except for ocherous scaling at costa; discal spot at end of cell ocherous edged with black; in cell, at basal fourth, an oblique black dash, between this and the outer discal spot an ill-defined line of black and ocherous scales; veins indistinctly indicated by a few black scales; around termen there is an indistinct row of small black spots; costa tinged with pink; cilia light fuscous, darker basally. Hind wing gray, darker toward margins; cilia very pale grayish fuscous with darker subbasal and subterminal bands. Legs buff heavily overlaid with fuscous and mixed with ocherous. Abdomen buff overlaid with grayish fuscous.

Male genitalia.—Harpe moderately long, gradually tapered to the bluntly pointed cucullus; clasper very slender, sharply excurved at distal end; basal process from sacculus finely spinulate, twisted and sharply pointed. Anellus broader than long, roughly bell-shaped. Aedeagus long, curved, pointed, with a small flattened dorsal process and broad flat ventral process at base. Vinculum narrow but broadened at middle. Transtilla narrow, weakly sclerotized, with poorly developed lobes.

Female genitalia.—Genital plate narrow, convex anteriorly at middle, without sclerotized anterior pockets; ostium slitlike. Ductus bursae membranous before ostium, then curved into a strongly sclerotized section, the latter ending about middle of ductus; inception of ductus

seminalis just before ostium. Signum a large, toothed, diamond-shaped plate.

Alar expanse, 18–22 mm.

Type.—U.S.N.M. no. 58009.

Type locality.—Gilmer, Klickitat County, Wash.

Food plant.—*Lomatium triternatum macrocarpum* (Coult. & Rose) Mathias.

Remarks.—Described from the ♂ type, 5 ♂ and 9 ♀ paratypes all from the type locality, collected by the author. Paratypes in the U. S. National and British Museums.

The larvae from which this series was reared were collected in the small village of Gilmer where the food plant was growing abundantly in an open field. The preponderance of larvae feeding in this locality were this species, but those found on the same plant a mile farther east were all *betina*. These larvae, like those of *betina*, feed in the umbels of the host.

This species is nearest *togata*, but differs from it by the evenly curved, thin, hooked clasper and by the twisted basal process from the sacculus. The sclerotized pockets from the anterior edge of the genital plate are absent in this species. The female of *togata* is not known.

In my color key *thustra* goes to the *angustatimultifidae* couplet. The darker color and the ocherous scaling of the forewing should separate *thustra* from the other two.

Depressaria togata Walsingham

I have examined the type ♂ which is in the Walsingham Collection of the British Museum. This specimen is labeled "Arizona" Morrison, 1882, and this locality was entered in the accession book by Durrant under number 35332 when the type was registered. According to Mr. Stringer, who worked with Durrant and Walsingham, and with whom I have discussed the matter, the locality was entered correctly and the type name, printed in caps, establishes beyond doubt the authenticity of the type specimen.

In publishing the description of this species[5] the type locality was recorded as Montana. In recording the type locality in my revision from the original publication I used the locality given. This should be changed to read ARIZONA.

[5] Insect Life **1**: 254. 1889.

Inga sparsiciliella (Clemens)

A single specimen of this species was submitted for determination through the port of entry at Laredo, Tex. The specimen is from San Luis Potosí, Mexico, and was reared from orchids. This is the first association of *sparsiciliella* with a food plant and is the first record for Mexico.

Genus **Garrha** Walker

Garrha Walker, *List of the specimens of lepidopterous insects in the collection of the British Museum* **35**: 1835. 1866. (Genotype: *Garrha sincerella* Walker.)

I have examined the female type of *sincerella* in the British Museum and have found several characters by which it is distinguishable from *Machimia tentoriferella* Clemens, the genotype of *Machimia*, with which Meyrick synonymizes *Garrha*.

In the hind wing of *tentoriferella* vein 5 is remote from connate 3 and 4; in *sincerella*, 4 and 5 are approximate.

The abdomen of the type was glued on but a comparison of its genitalia with other specimens of *sincerella* indicate the abdomen is the original. The abdomen is strongly spined. The signum is present.

The above characters will separate this genus from *Machimia* and I hereby remove *Garrha* from the synonymy.

Genus **Hoplomorpha** Turner

Hoplomorpha Turner, Proc. Linn. Soc. New South Wales **41**: 373. 1916. (Genotype: *Cryptolechia abalienella* Walker, *List of the specimens of lepidopterous insects in the collection of the British Museum* **29**: 762. 1864.)

This genus has been synonymized with *Machimia* by Meyrick. A study of the genotype *abalienella* shows that it possesses several characters by which it can be distinguished from *M. tentoriferella*, the genotype of *Machimia*.

In the forewing of *abalienella* veins 2, 3, and 4 are closely approximate; in *tentoriferella*, 2 is remote from 3. The discocellulars of the hind wing of *tentoriferella* are inwardly oblique but in *abalienella* they are straight except between 6 and 7.

The male genitalia of *abalienella* differ from those of *tentoriferella* in the following respects: The gnathos is unspined, long, slender, and curved. Vesica unarmed. The elements of the

transtilla and anellus are fused strongly to the middle of the harpe. Clasper divided. Abdomen strongly spined.

The female genitalia differ in having the signum present and the ductus bursae unsclerotized.

For the above reasons I am removing *Hoplomorpha* from the synonymy under *Machimia*.

In character the genitalia strongly suggest *Garrha* and this genus may be synonymous with *Hoplomorpha*.

Cryptolechia trigama Meyrick

Cryptolechia trigama Meyrick, *Exotic Microlepidoptera* **3**: 476. 1928.

The unique male type, from Fort Davis, Tex., is in the British Museum. I expressed doubt (p. 224) about the proper placement of this species when I assigned it to *Inga*, and a study of the type proved my misgivings were fully justified. Meyrick's species is not an *Inga* nor does it belong to any other genus now recorded from North America.

In venation it agrees with *Machimia* except 7 goes to apex and the termen is more rounded; but the ciliations of the antenna are shorter and more numerous. In *trigama* the second segment of the labial palpus is smooth in front, in *M. tentoriferella* it is rough.

The genitalia of the type of *trigama* are badly damaged but the clasper is absent, anellus with fleshy, flattened lateral processes extending beyond costa of harpe at base, cornuti (2) present. The gnathos and tegumen are missing. Abdomen not spined.

Although the generic placement of this species is still in doubt it would be unwise to add to the confusion by making another assignment until adequate material is obtained.

Cryptolechia diligenda Meyrick

Cryptolechia diligenda Meyrick, *Exotic Microlepidoptera* **3**: 477. 1928.

In placing this species as a synonym of *Himmacia huachucella* (Busck) I was entirely wrong.

Although Meyrick's short, specific description fits *huachucella* as well as *diligenda* the two are not congeneric, nor is *diligenda* congeneric with the genotype of *Cryptolechia*.

Meyrick's species is represented by a unique female in the British Museum, which I have examined, but until such time as the many oecophorid genera of South America are studied or we have obtained adequate material of this species from southwestern United States, the original generic placement should be used.

For the above reasons I am removing *diligenda* from *Himmacia* where I had placed it.

Genus **Thema** Walker

Thema Walker, *List of the specimens of lepidopterous insects in the collection of the British Museum* **29**: 802. 1864. (Genotype: *Thema brevivitella* Walker.)

On page 231 I expressed doubt that *Thema* and *Pleurota* were synonymous. An examination of Walker's type in the British Museum, revealed several differences between the genotypes of the two genera. *T. brevivitella* has a long, upturned terminal segment of the labial palpus; in *P. bicostella* (Clerck) the palpus is porrect. On the anellus of *brevivitella* there are no lateral processes and the vesica is strongly armed (a long, spiraled cornutus). The signum is present, but very weak, in *brevivitella* and the ductus bursae is not sclerotized at any point. The abdomen is spined as in *bicostella*.

Unquestionably *Thema* is closely related to *Pleurota* but the generic term *Thema* must be restricted to *brevivitella* and its congeners and is hereby removed from synonymy.

Genus **Phryganeutis** Meyrick

Phryganeutis Meyrick, Proc. Linn. Soc. New South Wales **9**: 742. 1884. (Genotype: *Phryganeutis cinerea* Meyrick.)

Phryganeutis has been synonymized with *Pleurota* but its type differs in several respects from *bicostella*.

The terminal segment of the labial palpus of *cinerea* is long and upturned, the clasper of the harpe is strongly developed, uncus present but reduced, and the gnathos is long and beaklike. The abdomen is spined.

For the above reasons I am removing *Phryganeutis* from the synonymy under *Pleurota*.

Genus **Atheropla** Meyrick

Atheropla Meyrick, Proc. Linn. Ent. Soc. New South Wales **9**: 758–759. 1884. (Genotype: *Atheropla melichlora* Meyrick.)

On page 271 I placed this genus as a synonym of *Eumeyrickia*, following Meyrick, but expressed doubt that the synonymy was correct.

Meyrick's type, which I have seen, belongs in the Oecophoridae, not Ethmiidae as it would

if a synonym of *Eumeyrickia*. The type of *A. melichlora* is in good condition. The abdomen is strongly spined as in *Pleurota*, the venation is the same except 2 is nearer 3 in the forewing in *Pleurota* than it is in *Atheropla*, and the palpi of the latter are upturned, not porrect as in *Pleurota*. In the hind wing of *melichlora* the discocellulars are inwardly oblique, as in *Pleurota*, from connate 3 and 4 and 5, 6, and 7 are almost parallel.

The bursa of *melichlora* is without signum and is simple.

Atheropla is distinct from *Eumeyrickia* and I am removing it from the synonymy of that genus. Whether or not it is synonymous with some Australian or other genus must await the study of the other genera.

Genus **Paratheta** Lower

Paratheta Lower, Proc. Linn. Soc. New South Wales **24**, pt. 1: 100. 1899. (Genotype; *P. ochrocoma* Lower, ibid. [Fletcher, Mem. Dept. Agr. India, ent. ser., **11**: 164. 1929 (subsequent designation)].)

Mixodetis Meyrick, Trans. Royal Soc. South Australia **26**: p. 172. 1902. (Genotype: *Paratheta ochrocoma* Lower, Proc. Linn. Soc. New South Wales **24**, pt. 1: 100. 1899 [Fletcher, Mem. Dept. Agr. India, ent. ser., **11**: 141. 1929, subsequent designation].) (New synonymy.)

When Meyrick proposed the name *Mixodetis* for *P. ochrocoma* Lower and *P. calyptra* Lower he omitted any reference to *P. lasiomela*, the third species included by Lower in his genus *Paratheta*.

Fletcher, following Meyrick, cited the type of *Mixodetis* Meyrick as *P. ochrocoma* Lower. Thus *Mixodetis* Meyrick becomes a synonym of *Paratheta* Lower.

Paratheta Lower was not described but three species (*P. calyptra*, *P. ochrocoma* and *P. lasiomela*) were described in the genus thus establishing the name.

Meyrick used the name *Paratheta* for the three species *P. syrtica*, *P. spodostrota* and *P philoscia* and designated *P syrtica* as the genotype. *Paratheta* Meyrick is a primary homonym of *Paratheta* Lower and for *syrtica* and its congeners I propose the name:

Pseudotheta, nom. nov.

Paratheta Meyrick (*not* Lower), Trans. Royal Soc. South Australia **26**: 173. 1902. (Genotype: *P. syrtica* Meyrick, ibid. [original designation].)

The type of *P. syrtica* (Meyrick) is in the Meyrick collection in the British Museum. Since Meyrick did not designate types I have selected as the lectotype a specimen from the type series from Sydney, New South Wales (6-9-84). This is a ♂ of which I have made a genitalic preparation. The species is referable to the Oecophoridae and is *not* related to *P. ochrocoma* Lower and its congeners.

The abdomen of *syrtica* is strongly spined. Harpe simple, without clasper. Uncus pointed. Gnathos spoon-shaped, short. Aedeagus stout, curved, sharply pointed, the distal end somewhat flattened.

Family Cosmopterygidae

Anoncia aciculata (Meyrick), n. comb.

Borkhausenia aciculata Meyrick, *Exotic Microlepidoptera* **3**: 468. 1928.

This species is referable to the genus *Anonica* as a study of the genitalia of the type reveals.

Aedeagus very long, slender, curved. Harpe rather long, rectangular; basal process of right harpe digitate, slender. Gnathos long, slender, sharply pointed and slightly curved ventrad distally. From the fused basal portion of harpes a stout, tubular, strongly sclerotized process tapers to a needlelike point.

Anoncia astigmatica (Meyrick), n. comb.

Paratheta astigmatica Meyrick, *Exotic Microlepidoptera* **3**: 467. 1928.—Gaede, *in* Bryk, *Lepidopterorum catalogus*, pt. **88**: 41. 1938.—McDunnough, *Check list of the Lepidoptera of Canada and the United States of America* (pt. 2, Microlepidoptera), No. 8368, 1. 1929.—Clarke, Proc. U. S. Nat. Mus. **90**: 39. 1941.

This species was described and placed in the Oecophoridae by Meyrick, but on characters of wing venation and the genitalia it is clearly a cosmopterygid. Meyrick's concept of the Oecophoridae was sufficiently broad to include this species but since it combines characters of both *Triclonella* Busck and *Anoncia* Clarke its transfer to the Cosmopterygidae is mandatory.

Until the Cosmopterygidae are thoroughly studied I am transferring *astigmatica* to *Anoncia* with which it agrees on all but one character of the male genitalia.

ENTOMOLOGY.—*A correction and two new races in* Graphognathus *(white-fringed beetles) (Coleoptera: Curculionidae).*[1] L. L. BUCHANAN, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. MUESEBECK.)

The name *Naupactus leucoloma* Boheman, or *Pantomorus (Graphognathus) leucoloma* (Boheman), has become familiar to entomologists of this country as specifying one of several closely related South American weevils, collectively known as white-fringed beetles, which are now established in the southeastern part of the United States. The recognition of the supposed *leucoloma* in North America dates from 1936, when I so identified specimens collected in that year near Svea, Fla. Through the courtesy of René Malaise, of the Stockholm Museum, I have recently had the opportunity of studying the type specimen of *Naupactus leucoloma* Boheman, and there can be no doubt that my 1936 identification was wrong and that this species, in its restricted sense at least, does not occur in the United States. As the "*leucoloma*" of North American entomological literature is now without a valid name, it is described as new in this paper. Another white-fringed beetle, discovered in North Carolina in 1942, is also described here for the first time.

Although no satisfactory way of classifying the white-fringed beetles as a whole has yet been worked out, it can be said that, of the seven distinguishable kinds present in the United States, two (*peregrinus* and *minor*) are sufficiently distinct to be regarded as species. The other five, however, along with the true *leucoloma* and many similar though still undescribed segregates from South America, exhibit exceedingly close and peculiarly involved relationships, and though these segregates are isolated from one another by parthenogenesis, it now seems evident that they are not species in the ordinary sense of the word; and in the present paper they are treated as races of the *leucoloma* complex. In addition, *Graphognathus*, formerly considered a subgenus of *Pantomorus*, is raised to generic rank. On such a plan the species and races of *Graphognathus* now known from the United States may be tabulated as follows, the true *leucoloma* of Boheman being included for purposes of comparison:

1. Rostrum distinctly tapering anteriorly, eye more convex (Fig. 12), lateral costa of dorsum of rostrum feebly prominent and not overhanging side of rostrum; median dorsal groove of head and rostrum with its apical portion not or faintly carinate and at most about twice as wide as basal portion, the scales each side of posterior half of groove broadly subovate and lying transversely or transverso-obliquely and in general directed toward midline (Fig. 17); scales and setae along posterior half of midline of pronotum directed posteriorly (Fig. 25); scales on disc of elytra subcircular or broadly ovate and nearly covering surface, the strial lines scarcely perceptible; a narrow bevel present on apex of hind tibia (Fig. 21). Length, 7–10.5 mm. Southern MISSISSIPPI: Harrison, Hancock, Pearl River, Jackson, Stone, Forrest, Covington, Simpson, and Hinds Counties. Southern ALABAMA: Grand Bay, Theodore, and Mobile. . . . . *peregrinus* (Buchanan)

   Rostrum not or less strongly tapering anteriorly, eye less convex (Figs. 9–11), lateral costa of dorsum of rostrum more prominent and more or less distinctly overhanging the side of rostrum just beneath it; median dorsal groove of head and rostrum with its apical portion carinate or not carinate and often considerably more than twice as wide as basal portion, the scales each side of posterior half of groove narrowly ovate to linear and lying longitudinally or longitudino-obliquely, the oblique ones directed toward side margins (Fig. 16); scales and setae along midline of pronotum directed anteriorly in general (Fig. 26); scales on disc of elytra oblong to broadly ovate and not covering surface so completely, the strial lines (except *pilosus*) more evident; hind tibia without distinct bevel (Fig. 22) except in *minor*. . . . 2

2. A distinct bevel present on apex of hind tibia (Fig. 20); setae on disc of pronotum appressed or nearly so; eye slightly less convex (Fig. 10); widened apical portion of rostral groove carinate; body shape characteristic (Fig. 2). Length 6.5–10.5 mm. Northwestern FLORIDA: Pensacola, Gonzalez, Cantonment, Bluff Springs, and Century. A single specimen at hand is labeled "Crestview, Fla.," but this locality is doubtful.

   minor (Buchanan)

   Bevel absent or virtually so (Fig. 22); setae on disc of pronotum, at least in part, sufficiently

[1] Received December 3, 1946.

elevated to be easily perceptible and sometimes conspicuous; eye a little more convex (Figs. 9 and 11); rostral groove carinate or not carinate (*leucoloma* complex).....3

3. Rostrum subevenly tapering from base to apex (Fig. 9); elytral intervals broadly but distinctly convex; widened portion of rostral groove carinate; setae on disc of pronotum numerous, slantingly suberect, and rather conspicuous; scutellum slightly impressed; prevailing color rather dark, about as in *dubius* and *striatus*. Length of type 10.5 mm. Tucuman, Argentina. Not in United States. (Fig. 3)....*leucoloma leucoloma* (Boheman)

Rostrum not tapering as above (Fig. 11); elytral intervals less convex or flat; other characters differing with the race.....4

4. Scales on disc of elytra, except on the short basal slope, subevenly spread over the intervals and strial rows, the latter thus being obscured; erect elytral setae a little longer and finer; rostral groove usually without carina, occasionally with a short, faint carina beginning at apex, but usually not extending posteriorly as far as middle of widened part of groove. Length 8–11.3 mm. Definitely known only from Monroe, Conecuh, and Wilcox Counties, Alabama. (Fig. 4)

leucoloma pilosus (Buchanan)

Scales on disc of elytra more concentrated on intervals than along strial rows, the latter, though often feebly defined, more evident than in *pilosus* and usually appearing to the unaided eye as parallel lines which are more or less distinctly darker than the intervals (Figs. 5–8); erect elytral setae a little shorter and stiffer; rostral groove carinate or not carinate, the carina, when present, usually longer than in *pilosus*.....5

5. Rostral groove carinate anteriorly; strial lines usually a little darker and more distinct; prevailing color brownish, darker.....6

Rostral groove not carinate; strial lines less distinct; prevailing color gray or gray-brown, lighter.....7

6. Elytra more strongly widened posteriorly (Fig. 6), intervals 2 and 4 not or scarcely perceptibly paler than adjacent intervals; prothorax narrower (see paragraph following key); metasternum more convex (Fig. 24). Length 9–12.7 mm. Southeastern Louisiana: Many localities in St. Bernard, Plaquemines, Jefferson, Orleans, St. Tammany, Tangipahoa, East Baton Rouge, and Iberia Parishes. Southern Mississippi: Harrison, Pearl River, Lamar, Forrest, Jefferson Davis, Jones, and Hinds Counties. Southern Alabama: Luverne, Chilton, and Grand Bay. Georgia: Many localities between Cornelia on the north and Irwinville on the south, and between Columbus on the west and Sylvania on the east. South Carolina: Columbia. The localities Pensacola, Fla., and DeLisle, Miss. (one specimen each), require confirmation

leucoloma striatus (Buchanan)

Elytra little widened posteriorly, sides usually appearing subparallel (Fig. 5), intervals 2 and 4 in apical halves often paler than adjacent intervals, prothorax broader; metasternum less convex. Length 8.5–12.2 mm. Southern Mississippi: Moss Point (these specimens were formerly placed with *striatus*), Maxie, Hattiesburg, and Camp Shelby. Southern Alabama: Mobile, Toulmanville, Blakeley Island, Crichton, Prichard, Irvington, Foley, Peterman, Natchez, Buena Vista, Tunnel Springs, Martins Station, and Selma. Northwestern Florida: Century. North Carolina: Peachland, Marshville, Polkton, and Burgaw. A few specimens, not positively identifiable though probably belonging to *dubius*, are labeled "Nadawah" and "Neenah, Ala.," and "Gulfport, Miss."

leucoloma dubius (Buchanan)

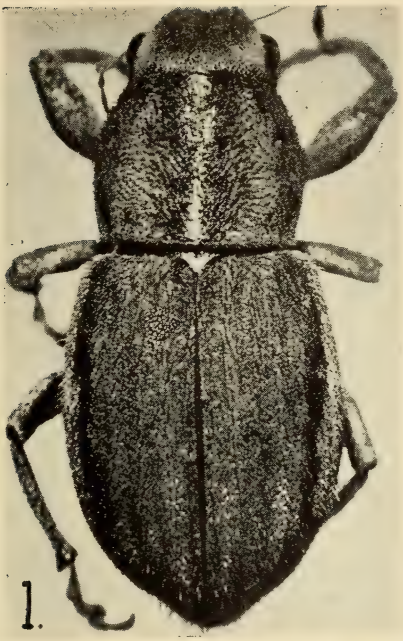
7. Size slightly smaller; scales and setae along midline of pronotum in general directed anteriorly or somewhat obliquely, a few of those in a small area about midpoint sometimes dearranged and pointing in various directions (Figs. 13 and 19); metasternum less convex (Fig. 23). Northwestern Florida, southern Alabama, and southern Mississippi.....*leucoloma fecundus*, new race

Size a little larger; scales and setae along midline of pronotum about as in *fecundus* except in a small area near midpoint where many of them often lie either transversely, or at least more strongly obliquely than in *fecundus* (Fig. 14); prothorax broader (see paragraph following key); metasternum slightly more convex. North Carolina

leucoloma imitator, new race

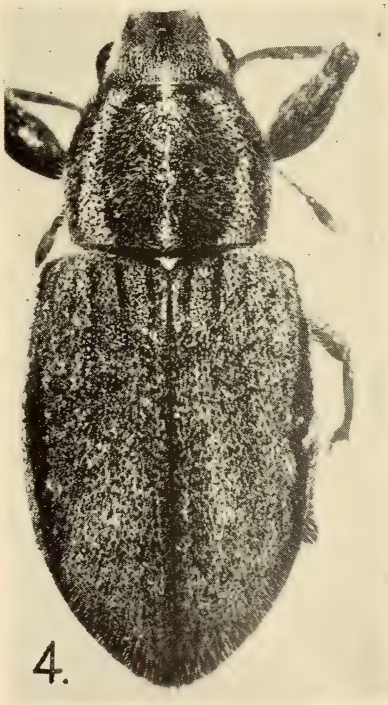
The mean ratio of the length of the prothorax divided by its breadth for the preceding five races is as follows, the figures in parenthesis indicating the number of specimens measured: *pilosus*, 0.800 (48); *striatus*, 0.828 (216); *dubius*, 0.801 (357); *fecundus*, 0.756 (408); *imitator*, 0.744 (256).

The distribution in South America of the white-fringed beetles present in the United States is still very imperfectly known. Three of them (*dubius*, *pilosus*, and *imitator*) have not been definitely recognized among the South American collections at hand. Of the others, a single old specimen of *striatus*, labeled "Cordoba" [Argentina], agrees closely with certain small specimens of this race from the United States; a specimen, almost certainly of *fecundus*, was collected at San Antonio, Uruguay,









GRAPHOGNATHUS

FIGS. 1–4.—1, *peregrinus*, Gulfport, Miss.; 2, *minor*, Cantonment, Fla.; 3, *leucoloma leucoloma*, type, Tucumán, Argentina; 4, *leucoloma pilosus*, Repton, Ala. Photographs by M. L. F. Foubert.





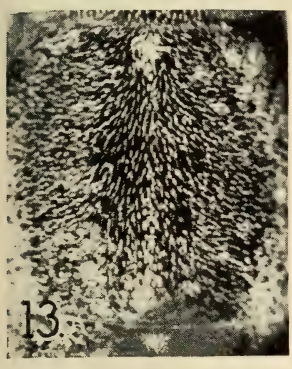


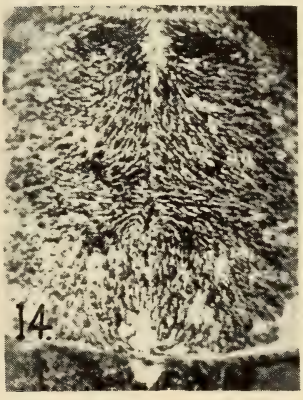


FIGS. 5–8.—5, *leucoloma dubius*, Mobile, Ala.; 6, *leucoloma striatus*, New Orleans, La.; 7, *leucoloma fecundus*, Florala, Ala.; 8, *leucoloma imitator*, Wilmington, N. C. Photographs by M. L. F. Foubert.

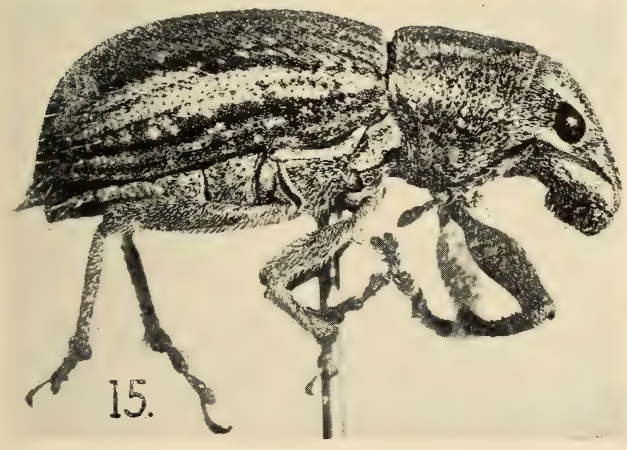








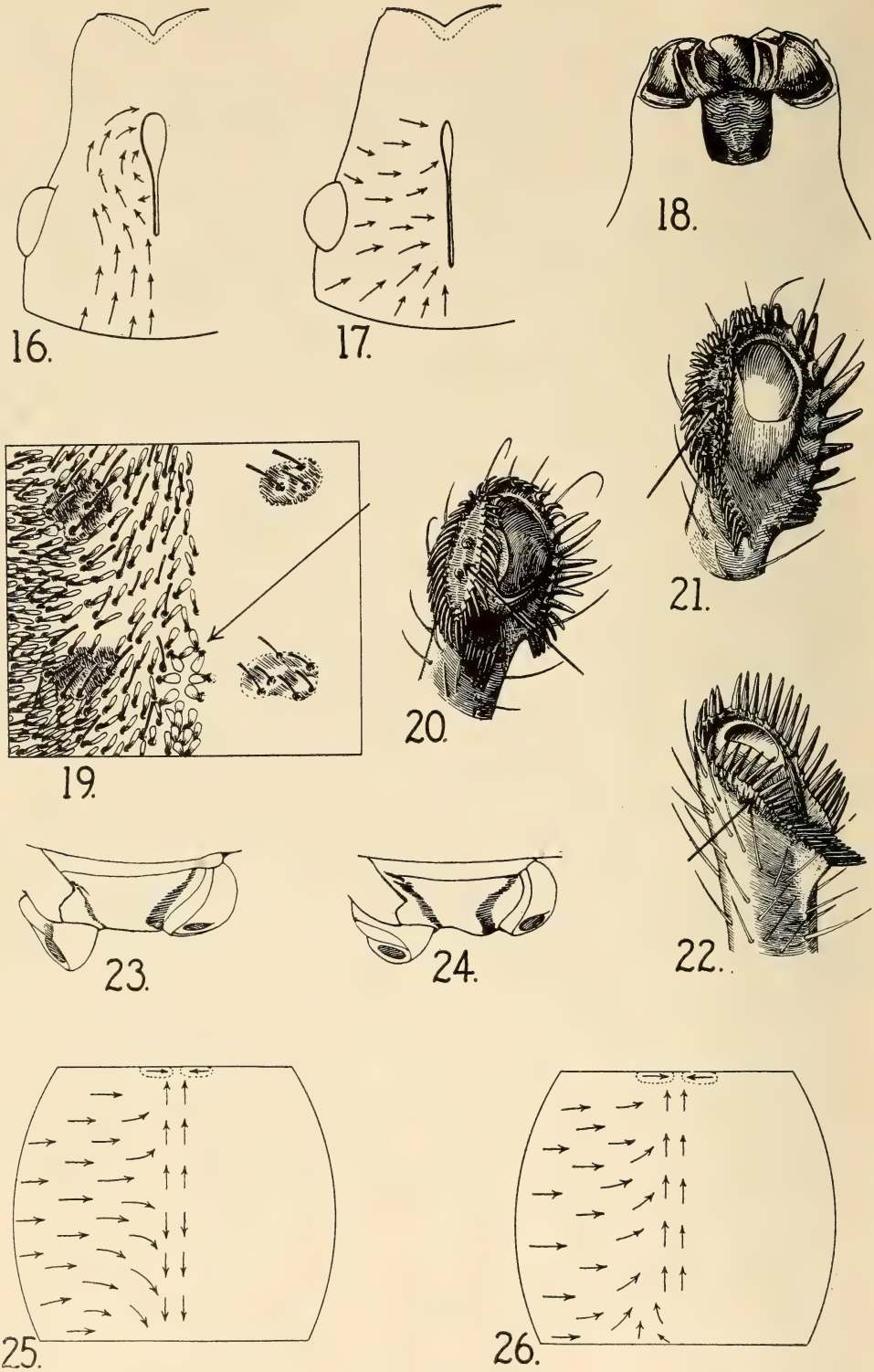






GRAPHOGNATHUS

FIGS. 9–15.—9, *leucoloma leucoloma*, dorsal view of head; 10, *minor*, same; 11, *leucoloma fecundus*, same; 12, *peregrinus*, same; 13, *leucoloma fecundus*, median area of pronotum, showing directional trend of vestiture; 14, *leucoloma imitator*, same, specimen having the transverse arrangement of vestiture near midpoint unusually well developed; 15, *leucoloma fecundus*, side view. Photographs by M. L. F. Foubert.



Figs. 16–26.—(See opposite page for legend).

by Paul Berry; a few specimens of *peregrinus* were collected at Santa Fé, Argentina, by H. L. Parker; and a specimen of *minor* was taken at Buseo, Uruguay, by Silveira. Of the true *leucoloma* of Boheman I have seen only one specimen, the type, labeled "Tucuman."

Graphognathus leucoloma fecundus, n. race

Figs. 7, 11, 13, 15

Naupactus leucoloma North American authors, not Boheman; *Pantomorus (Graphognathus) leucoloma* Buchanan, U. S. Dept. Agr. Misc. Publ. 341: 12. 1939; Bull. Brooklyn Ent. Soc. 37: 110. 1942, not *leucoloma* Boheman; *Pantomorus leucoloma* North American reports.

Length 8–12 mm; width 3.4–5.6 mm. Prevailing color above gray or gray-brown, the elytra sometimes feebly variegated with irregular gray and brown splotches. Elytra with scales usually dense on intervals, less dense along strial rows, the scales abruptly paler (pearly white) in a broad lateral stripe beginning on humerus and extending to apex; setae erect or slanting, some of them shorter, more or less curved, and more numerous, the others sparser, much longer, and straight or nearly so. Pronotum with a curved, not sharply defined, sublateral line of pale or whitish scales.

Dorsal surface of rostrum scaly and setose, the median groove broadly dilated anteriorly, the dilated part not carinate; lateromarginal costa shiny, usually bare or nearly so at summit. Prothorax transverse, upper surface with appressed scales ranging in shape from ovate to linear, and with inclined, curved setae, the scales broader and denser laterally than medially, vestiture along midline usually directed longitudinally or somewhat obliquely, except in a small area located usually just posterior to midpoint of pronotum where a few of the scales and setae are sometimes much confused in arrangement and point in various directions. Scutellum usually not impressed. Elytral intervals broadly, feebly convex, often appearing flat. Under side and legs scaly and setose. (For more detailed description see Buchanan, 1939, pp. 11–13.)

Type locality.—Florala, Ala. July 14, 1937. P. N. Annand. On cotton.

Type and 110 paratypes (all from Florala and immediate vicinity and Lockhart, Ala.), No. 58152, United States National Museum.

Specimens in the National Museum collection are from the following localities: Southern MISSISSIPPI: Poplarville and Lumberton. Southern ALABAMA: Geneva County, Florala, Lockhart, Opp, Flomaton, Evergreen, Atmore, Vocation, Foley, Drewry, Burnt Corn, Monroeville, Peterman, Tunnel Springs, Beatrice, Buena Vista, Nadawah, McWilliams, Pleasant Hill, Martins Station, and Dallas County. Northwestern FLORIDA: De Funiak Springs, Glendale, Crestview, Svea, Pensacola, Gonzalez, Bluff Springs, Byrnville, and Century.

A few specimens collected between 1939 and 1941 are labeled "Lake Arthur," "Baton Rouge," "Poydras," and "New Orleans," La., but as no Louisiana specimens have been reported since 1941, the actual establishment of *fecundus* at these places may be doubted. Similarly, the establishment of *fecundus* at Gulfport, Miss. (1 specimen), Hattiesburg, Miss. (1 specimen not now at hand), and at Mobile, Ala. (2 specimens), needs corroboration.

Graphognathus leucoloma imitator, n. race

Figs. 8, 14

Length 8.5–13 mm; width 3.5–6 mm. Prevailing color above gray-brown, size slightly larger than in *fecundus*. Head and rostrum as in *fecundus*, except that the dilated part of median groove on dorsal surface averages a little wider and apparently shallower. Prothorax relatively a little broader and its upper surface somewhat

FIGS. 16–26.—16, Diagram of upper surface of head and rostrum to show directional trend of vestiture in the *leucoloma* complex and in *minor;* 17, same of *peregrinus;* 18, ventral view of rostrum, showing the mandibular sulci of *Graphognathus;* 19, middle of pronotum, showing "area of confusion" (arrow) sometimes present in *lecuoloma fecundus* and in other races of the *leucoloma* complex; 20, *minor*, apex of hind tibia, showing bevel; 21, *peregrinus*, same, the bevel present but not so well defined as in *minor;* 22, same, showing the narrow, feebly defined area, corresponding to a bevel, sometimes present in specimens of the *leucoloma* complex; 23, flat metasternum characteristic particularly of *leucoloma fecundus;* 24, convex metasternum more or less characteristic of *leucoloma striatus;* 25, diagram of pronotum, showing directional trend of vestiture in *peregrinus;* 26, same of *leucoloma fecundus*, and in general of the *leucoloma* complex; also of *minor*. (Area of confusion not indicated; see Fig. 19.) Drawings by Arthur Cushman.

more coarsely sculptured than in *fecundus;* vestiture at or a little behind midpoint of pronotum often transverse or transverso-oblique in direction. Scutellum densely clothed with white scales and more often impressed than in *fecundus.* Otherwise as in *fecundus.*

Type locality.—Wilmington, N. C. July 13, 1942. ACL railroad track. GWRD-47B.

Type and 115 paratypes (all from Wilmington and vicinity), No. 58153, United States National Museum.

Specimens have been examined from the following places in North Carolina: Cape Fear, Wrightsboro, Wilmington, Castle Hayne, Rocky Point, St. Helena, Burgaw, Jacksonville, Kellum, Atkinson, Ivanhoe, Bladenboro, Lumberton, Hope Mills, Vander, Warsaw, Goldsboro, Kinston, Dover, and Greensboro.

This race is exceedingly close to *fecundus,* and no uniformly reliable way of separating them is known; and single specimens or small lots of both races can sometimes be identified only by locality. Statistical study of long series, however, indicates that *fecundus* and *imitator* are separate entities, even though they merge more or less imperceptibly in all characters and character combinations. Possibly *imitator* may be something in the nature of a recent mutation of *fecundus* but, if so, there still remains the need, from a taxonomic standpoint, of recording those differences that do exist.

In the many hundreds of specimens of each race examined, the single feature which has proved most useful as a distinguishing mark (though far from an invariable one) is found in the direction taken by the vestiture on and bordering the median line of the pronotum. In most specimens of *fecundus* the vestiture along this line points either longitudinally or slightly mesad (Fig. 13), though in a small area usually located just posterior to the midpoint of the pronotum and which may be termed the "area of confusion" (Fig. 19), there is occasionally a more or less marked dearrangement of the vestiture, in which case some of the setae and scales are more obliquely, or even transversely or backwardly, directed. In general, however, the vestiture along the median line of the pronotum in *fecundus* points longitudinally or nearly so. In *imitator,* especially in medium- and large-sized specimens, the vestiture in the area of confusion is oftener transverse in direction, or more nearly transverse than in *fecundus;* and the number of setae and scales having a transverse or obliquely transverse direction is usually greater than in *fecundus* (Fig. 14). The somewhat coarser pronotal sculpture of *imitator* is also a useful character in series.

HERPETOLOGY.—*A new musk turtle from Southeastern United States.*[1] Hobart M. Smith and Bryan P. Glass, Agricultural and Mechanical College of Texas, College Station, Tex. (Communicated by Herbert Friedmann.)

Included in a small collection of reptiles and amphibians from Mississippi, kindly donated to the Texas Cooperative Wildlife Collections (herein indicated as TCWC) at the Agricultural and Mechanical College of Texas by Helmut K. Buechner, is an adult *Sternotherus* remarkable as the second known example of a species anticipated as long ago as 1895 by Samuel Rhoads, but neglected and confused with *S. minor* by subsequent authorities.

For the use of comparative material without which our study could have come to no satisfactory conclusion, we are indebted to Dr. Doris M. Cochran, of the U. S. National Museum, and Dr. Cornelia Smith, of Baylor University. We are deeply grateful to Helmut Buechner for his kindness in providing the Mississippi material.

[1] Received October 3, 1946.

Sternotherus peltifer,[2] n. sp.

Striped Musk Turtle

Holotype.—TCWC No. 1205, male, from Bassfield, Jefferson Davis County, 30 miles west of Hattiesburg, Miss., collected on June 4, 1946, by Helmut K. Buechner.

Diagnosis.—A member of the genus *Sternotherus* with a single sharply defined median

[2] From Latin: *pelta,* a very short buckler or target in form of a half-moon; *fer,* bearing. Used in reference to the small, slender bridge scutes.

keel, gular plates greatly reduced, and two mental barbels. Similar in these respects to *S. carinatus* from which it differs as follows: (1) axillary and inguinal plates reduced in size, much longer than broad; (2) second, third, and fourth vertebral shields broader than long; (3) humerals short and broad; and (4) carapace relatively rounded in cross section. Most closely related to *S. minor*, from which it differs in lacking lateral keels. Unique in having distinct stripes on head and neck and a pair of gular vestiges.

Description of holotype.—Carapace smoothly and symmetrically oval in dorsal profile, width about 0.75 of length, depth slightly greater than 0.33 of length; rear edge of carapace very feebly flared, not notched medially. Plastron narrow, anterior lobe slightly wider and shorter than posterior lobe (along median line), bridge slightly less than 0.25 of total plastral length. Head moderately large; upper jaw very feebly and lower jaw rather strongly hooked; numerous longitudinal rows of fine papillae on neck; two chin barbels. Tail extending beyond carapace for more than half its length, very slightly unguiculate, tip conical; numerous short fine papillae on tail, dispersed both irregularly and in rows. Rasping organ small, compact, each section oval in outline, very well defined.

Dorsal plates relatively loosely imbricate (as compared with, e.g., *S. odoratus*); first vertebral long and narrow, triangular, apex truncate, greatest width somewhat less than half greatest length; second, third and fourth vertebrals diamond-shaped to pentagonal, deeply overlapping, each a little wider than long; fifth vertebral pentagonal, only slightly longer than broad; costals four, typical, anterior longest, posterior smallest; nuchal very small; marginals eleven on each side, posterior two on each side more elevated than others, none less than about half as high as long, none serrate although posterior edge of each of rear four scutes on either side slightly overhanging anterior edge of succeeding scute. Median plastral sutures extensively and other plastral sutures narrowly bordered by incompletely cornified epidermis. Gular shields vestigial, paired; humerals short, broad; pectorals quadrangular, their median suture more than half as long as their lateral margin. Abdominals quadrangular, the lateral portion extending past the border of the plastron to form the greater part of the bridges. Axillaries and inguinals much reduced, a little more than three times as long as wide, latter twice size of former, together barely serving to separate lateral margins of abdominals from contact with marginals. Femorals and anals quadrangular. Posterior margin of plastron broadly emarginate, sides of emargination forming an angle of about 105°, width about half greatest width of posterior lobe; anterior margin of plastron truncate and slightly indented.

Dorsal scutes dark olive-brown, their free margins outlined with black; obscure, short, dark streaks radiating from posteromedial corner and evident chiefly toward the margin of each scute. Plastral shields yellow, feebly edged with brown; naked skin of plastron whitish. Neck and posterior half of head dark gray-brown, with bright yellow stripes above and on sides averaging 1.5 mm in width (same as dark interspaces), yellow below and with large dark patches. Frontal region with indistinct round dark spots; a few irregular dark spots on anterior temporal region; rostrum and upper jaw clouded, lighter toward lips; lower jaw with longitudinal brown streaks. Superior and anterior surfaces of forlegs dark and with distinct, irregular, longitudinal light streaks; hind legs dark, feebly marked; tail likewise irregularly marked, more clearly toward tip.

Measurements (in mm).—Carapace length 85.7; carapace width (greatest) 63.8; plastral length (median line) 57.9; maximum width anterior lobe 34.2; maximum width posterior lobe 29.6; length anterior lobe 18.7; length posterior lobe 21.9; bridge length 13.1; width of posterior plastral notch 15; depth of notch 4.1; median pectoral suture 11.1; lateral pectoral margin, 17; abdominal width 24.2; inguinal 3×9.5; axillary 1.9×7.8; humerals 6.2×12.2; second vertebral 22.6 (width) $\times 21.2$ (length, maximum); third vertebral 23.3×20.1; fourth vertebral 20.8×18.7; fifth vertebral 18.8×19.5.

Discussion.—The species represented by the present specimen is somewhat intermediate in some respects between *S. carinatus* and *S. minor*. It is, however, abundantly different from both and possesses a few distinctive characters of its own. No other described species of *Sternotherus* is known to have the peculiarly marked head and neck, with many well-defined stripes.

However Rhoads (Proc. Acad. Nat. Sci. Philadelphia **49**: 384–386. 1895) describes a specimen from the Emory River at Harriman, Roan County, Tenn., with an apparently identical pattern and similar structure; almost beyond question Rhoads' specimen is referable to *S. peltifer*. If properly allocated, it indicates a considerable range for the species, from eastern Tennessee to southern Mississippi. The eastern and western limits of the range are problematical.

It is noteworthy that Stejneger (Proc. U. S. Nat. Mus. **62** (art. 6): 2–3. 1923) and Pope (Turtles U. S., Canada: 48. 1939) allocate Rhoads' specimen with *S. minor*. The latter species, however, possesses three keels and has a spotted head. Rhoads describes his specimen as being "strongly keeled," and fails to mention lateral keels; likewise he describes stripes on the head. These features are reproduced in the Mississippi specimen.

Perhaps of considerable interest is the fact that *S. peltifer* shares its range with only one other of the genus: *S. odoratus*. It is bordered on the east by *S. minor*, on the west by *S. carinatus*, while *S. odoratus* overlaps the ranges of all three. These facts suggest that *S. peltifer* belongs to the section of the genus including *S. minor* and *S. carinatus*. It is of interest to speculate that these three forms may even be subspecies; if not they appear at least to be members of a single artenkreis.

The probable relationship of *S. peltifer*, *S. minor*, and *S. carinatus* is indicated by more than geographic ranges. They are all of similar superficial appearance (witness the frequent records by early authors of *S. minor* under the name of *S. carinatus*), and of much the same body shape and color. Rhoads' reference of one specimen of *S. peltifer* to *S. carinatus*, while Stejneger and Pope refer the same to *S. minor*, is evidence enough that the several species are confusingly alike. Differences between them are as follows:

S. carinatus: axillary and inguinal plates very large, nearly or quite as broad as long; second, third, and fourth vertebrals longer than broad; humerals very large, their median suture at least two-thirds length of their suture with pectorals; head dark-spotted on a light background; no lateral keels; gular plates absent or vestigial.

S. peltifer: axillary and inguinal plates small, much longer than broad; second, third, and fourth vertebrals broader than long; humerals smaller, their median suture not more than one-half length of their suture with pectorals; head dark-striped on a light background; no lateral keels; gular plates paired, vestigial, much broader than long.

S. minor: axillary and inguinal plates smaller, much longer than broad; second, third, and fourth vertebrals broader than long; humerals smaller, their median suture not more than one-half length of their suture with pectorals; head dark-spotted on a light background; lateral keels present; gular plate single, of normal shape, about as broad as long.

In comparison it can be seen that in the six characters discussed, *S. carinatus* is unique in three, shares one with *S. minor* and two with *S. peltifer*. The latter is unique in one, and shares three with *S. minor*, which in turn is unique in one character. It is obvious that *S. peltifer* is apparently more closely related to *S. minor* than to *S. carinatus*.

S. odoratus, which belongs in another group, has two light lines on each side of the head, more than two chin barbels, very low marginals, and usually a large gular. Its variation is considerable throughout its range, but these characters appear to be relatively constant and indicate relatively little relationship with *S. peltifer*. Since it occurs in the same area as the latter species their relationship is probably not close; they no doubt represent two entirely different artenkreisen.

Specimens examined.—Comparative material available includes the following: *S. minor* (2): Baker County, Ga. (Baylor Univ. No. 2058); Mimsville, Baker County, Ga. (Baylor Univ. No. 2059). *S. carinatus* (25): Mississippi: Black River Crossing (near Vicksburg?) (U.S.N.M. nos. 59958–60). Louisiana: Hope Villa (=Bullion), Ascension Parish (U.S.N.M. nos. 64603–13); Mermentau, Acadia Parish (U.S.N.M. no. 100095); Mermentau River, opposite Mermentau, Jefferson Davis Parish (U.S. N.M. no. 100094). Texas: Black Lake (17 miles NNE. of Bryan) and Wickson Lake, Brazos County (TCWC, 3); Tom Bull, Harris County (TCWC, 1); Twin Lakes, Madison County (TCWC, 4); 3 miles east of Evergreen, San Jacinto County (TCWC, 1).

ORNITHOLOGY.—*The southernmost race of the white-browed rufous piculet.*[1] Deignan, U. S. National Museum.

Some time ago (U. S. Nat. Mus. Bull. 186: 254. 1945) I suggested that the population of *Sasia ochracea* resident in southern Tenasserim and peninsular Siam at the Isthmus of Kra would require separation from more northern birds by virtue of the color of its orbital skin, but then refrained from naming it because of doubt as to the characters of *S. o. reichenowi*, described from central Tenasserim. There is now good evidence for the belief that the name *reichenowi* must be employed for the birds tentatively identified as *querulivox* (*loc. cit.*, pp. 253–254), and since the southernmost race is thus left without a name, I propose that it be called—

Sasia ochracea hasbroucki, n. subsp.

Type.—Adult female, U.S.N.M. No. 173000, collected at Maliwun, Mergui District, Tenasserim Division, Burma, on March 22, 1900 by William Louis Abbott.

Diagnosis.—From *S. o. reichenowi* (Thayetchaung, Tavoy District, Tenasserim), separable by its much more robust bill and by having the naked skin of the orbital region blackish or slaty (in the type "leaden") instead of deep crimson or crimson-like.

Range.—From the Isthmus of Kra and the shores of the Pak Chan Estuary north (at least on the eastern side of the Malay Peninsula) to (apparently) about latitude 12°30′ N.

Remarks.—Study of numerous species has shown that the birds resident in the adjoining districts of Tavoy and southwestern Siam are racially inseparable. Since it is now known that the population of the latter area comprises red-orbited birds of the northern type, it may be asserted with confidence that topotypes of *reichenowi* will be the same.

I have before me only two specimens from Maliwun, but four others from the Isthmus of Kra have been reported by Robinson and Boden Kloss (Journ. Nat. Hist. Soc. Siam **5**: 201. 1923) as having the "orbits black, blackish red, dark slate or slate."

Meyer de Schauensee (Proc. Acad. Nat. Sci. Philadelphia **98**: 38. 1946) has recorded two specimens from Ban Kaeng Sok (at about latitude 12°40′ N.) as having the orbital region black but the bill slender rather than robust. Since they come from a place at a latitude just halfway between those of Thayetchaung and Maliwun, it would appear that the two races intergrade in this vicinity.

The new woodpecker is named for my friend Edwin M. Hasbrouck, M.D., a volunteer worker in the Division of Birds, United States National Museum.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received January 2, 1947.

PHILOSOPHICAL SOCIETY

1253d Meeting

The 1253d meeting was held in the Cosmos Club Auditorium, October 13, 1945, President WAIT presiding.

Program: ARTHUR E. RUARK, Naval Research Laboratory: *A plan for scientific progress in pure physics.*—Attention was called to the haphazard methods that have prevailed in building up our fundamental picture of the physical universe. All too often great discoveries have been made against odds, by individuals working with meager resources. Nothing can replace the insight of the gifted investigator. Nevertheless the suggestion is made that by *group* effort general plans can be made for the advancement of pure physics—plans that would provide favorable conditions for rapid progress.

To make this point clear, the current situation in two broad fields of investigation was surveyed, and lines of advance feasible in the immediate future were indicated. These fields are:

(1) The discovery of additional fundamental particles.

(2) The interaction of fundamental particles with each other.

Reasons were advanced for the belief that many elementary particles and combinations of elementary particles remain to be discovered, and that some of them may be found by methods now available. The free magnetic pole was cited as an example. The incompleteness of our knowledge of the interactions between known particles was discussed. Studies of the electron-electron collision at North Carolina were described to illustrate the fact that many man-years must still be devoted to this fundamental problem.

It was pointed out that a very light atom composed of one electron and one positron must exist. The name "positronium" was proposed for this entity. The detection and study of this atom would provide very desirable checks of the theory of hydrogenic atoms in general, and of the interaction of electrons and positrons in particular.

To insure systematic, continuous attack on such essential problems, it was proposed that a number of institutes devoted to pure physics should be established, with a life of five years, and no more. At the end of that time the scientific personnel of the institute would be required to make other connections in order to spread their influence into other institutions—academic or commercial, as the case might be. The general scientific position would be reassessed and another group of five-year institutes would be launched with fresh personnel. The business of the institutes would be *discovery*, not application of discoveries. (*Author's abstract.*)

1254th Meeting

The 1254th meeting was held in the Cosmos Club Auditorium, October 27, 1945, President WAIT presiding.

Program: T. CASPERSON, Karolinska Institutet, Stockholm, Sweden: *Cytochemical studies of protein metabolism in mammalian cells.*

1255th Meeting

The 1255th meeting was held in the Cosmos Club Auditorium, November 10, 1945, President WAIT presiding.

Program: WADE H. MARSHALL, Johns Hopkins University: *The dynamics of the central nervous system with special reference to vision.*—Electrical examination of the sensory systems has garnered much information concerning physiological operation and anatomical organization. The primary sensory systems from periphery to cortex exhibit continuous activity and sensitivities near the noise level of the environment. One type of activity is the alpha rhythms. They are typically observed in cortical neurones when attention processes are relaxed, show some characteristics of relaxation oscillators, and are sufficiently orderly that Fourier analysis has been useful. The neurones which conduct and elaborate the impulses from the periphery show some similar rhythmicity, and, in general, time functions of activity are clearly revealed by examination of the systems by definitely patterned stimuli sequences. An excitability cycle is then revealed which exhibits a major phase, the duration of which is

the same order of magnitude as the fundamental alpha rhythm of the cortex.

A single stimulus repeated at fixed intervals elicits a local response at the cortex and by this means the projection of the periphery on the cortex has been mapped out, adding a wealth of detail to the knowledge of anatomical organization and introducing new facts and concepts to anatomy, physiology, and phylogeny.

When the time dimension in the stimuli pattern is further examined it is seen that interaction among contiguous neurones occurs in the reciprocally overlapping and multiplying pathways of the ascending neurones of the visual system. This interaction operates to transmit and enhance minor activity gradients on the retina while integrating lines and areas. This mechanism is directly applicable to the problem of vernier acuity and contour discrimination. Theoretical considerations extend to other problems such as the bipartite field. (*Author's abstract.*)

Mr. H. B. MARIS presented an informal communication on cycle analysis.

1256th Meeting

The 1256th meeting was held in the Cosmos Club Auditorium, November 24, 1945, President WAIT presiding.

Program: JOHN KRANTZ, Department of Pharmacology, University of Maryland: *The mechanism of action of anti-bacterial drugs.*—The historical development of the arsenical drugs was considered with special emphasis on their mechanism of action. The sulfonamides and their application in the treatment of various infectious diseases were reviewed. The discovery of antibiotic substances, such as penicillin and streptomycin, was related with special attention devoted to their mechanism of action. (*Author's abstract.*)

RALPH W. G. WYCKOFF, National Institute of Health: *Shadowed electron micrographs.*—With R. C. Williams, of the University of Michigan, a method has been developed for enhancing the contrast in electron microscopic preparations. This consists in obliquely evaporating a very thin metallic film over the surface in question. Such directed surface staining makes it possible to measure the heights of objects by the lengths of the permanent "shadows" they cast during evaporation, to see fine detail on replicas which otherwise would be too transparent to exhibit the structure they contain and to see the shapes and sizes of objects of macromolecular dimensions. Lantern slides illustrated the application of this shadowing to the examination of replicas of different kinds of surfaces including several prepared for metallographic study, and to the photography of viruses and biological macromolecules. (*Author's abstract.*)

1257th Meeting

The 1257th meeting, constituting the 75th annual meeting, was held in the Cosmos Club Auditorium, December 8, 1945, President WAIT presiding.

The treasurer reported that the income from dues and interest on investments was $1,357.20 and that the expenditures were $1,206.72, leaving a net gain of $150.48 on ordinary expenses. The ordinary expenses were at the rate of $3.45 per member. The total estimated assets of the Society showed an increase of $927.98 during the year to $16,649.19 on December 1, 1945.

The Secretaries' joint report showed an active membership as of December 1, 1945, of 347, of whom the following 19 were new members: LADISLAV BOOR, WILLIAM F. BROWN, VICTOR W. COHEN, DEAN B. COWIE, BERNHARD EPSTEIN, MARTIN GARSTENS, CURTIS L. HEMENWAY, CHARLES A. LITTLE, JR., A. V. MASKET, EDWARD DER MATEOSIAN, RICHARD G. NUCKOLLS, HARRY POLACHEK, ARTHUR E. RUARK, EMIL D. SCHELL, WILLIAM SCHWEDER, JANET SNYDER, ALFRED D. SOLLINS, M. H. TRYTTEN, and FRANCIS VANE.

The Secretaries reported the death of ROY B. HUNTER and M. L. ZIMMER.

Following the report of the Committee on Elections, the following officers were declared elected for the year 1946: *President,* FRANCIS M. DEFANDORF; *Vice-Presidents,* FRED L. MOHLER and WALTER RAMBERG; *Corresponding Secretary,* FRANCIS E. JOHNSTON; *Treasurer,* FRANK C. KRACEK; *Members-at-Large of the General Committee,* SCOTT E. FORBUSH and JAMES H. TAYLOR.

Program: PAUL F. BARTUNEK, National Bureau of Standards: *The significance of the symbols of physics.*—An attempt was made to clarify the confusion resulting from a failure to appreciate the meaning of words and symbols.

The system developed by Korzybski in his book *Science and sanity* contains a wealth of pertinent material.

The ideas of physics are originally on a nonverbal laboratory level. A language becomes necessary for a description of the phenomena. To be useful in physics and other fields the structure of the language must be similar to the observed phenomena. It is through similarity of structure alone that the language of pure mathematics becomes useful as applied mathematics.

Some common semantic blunders are (Weinberg, Amer. Journ.. Physics **7**: 104. 1939):

(1) Substitution of facility in manipulation of symbols for understanding of structural similarity.

(2) Use of symbols whose structure does not correspond to that of the physical referent.

(3) Inability to extend the domain of a physical symbol.

If one is aware at all times that symbols are *not* the things talked about; that not all aspects of a physical situation can be covered by a single symbol, and that what appears as a single symbol represents different aspects in different contexts—he will gain a flexibility of viewpoint which is useful in overcoming these difficulties. (*Author's abstract.*)

1258th Meeting

The 1258th meeting was held in the Cosmos Club Auditorium, January 5, 1946, President DEFANDORF presiding.

The retiring President, G. R. WAIT, of the Department of Terrestrial Magnetism, delivered his presidential address on the subject *Some experiments relating to the electrical conductivity of the lower atmosphere.* This address was published in this JOURNAL (**36**: 321–343. 1946).

1259th Meeting

The 1259th meeting was held in the Cosmos Club Auditorium, January 19, 1946, President DEFANDORF presiding.

Program: G. H. DIEKE, Johns Hopkins University: *Direct intensity measurements of spectrum lines with phototubes.*

1260th Meeting

The 1260th meeting was held in the Cosmos Club Auditorium, February 2, 1946, President DEFANDORF presiding.

Program: A. V. ASTIN, National Bureau of Standards: *The development of the radio proximity fuze for bombs and rockets.*—Radio proximity fuzes for bombs, rockets, and shells were developed and produced under a joint cooperative program involving OSRD, the Army and Navy, and numerous universities and industrial laboratories. The shell fuze program was the responsibility of the Navy and Section T of OSRD with central laboratories at the Applied Physics Laboratory of Johns Hopkins University. The bomb and rocket fuze program was the responsibility of the Army and Division 4 of NDRC with central laboratories at the National Bureau of Standards.

Radio proximity fuzes are sensitive to approach to a target, either an airplane or the ground, because of the interaction of a transmitter in the fuze with reflected waves from the target (Doppler effect). Sensitivity is determined by radiation characteristics and by properties of an audio frequency amplifier for the interaction signal.

In addition to an oscillator, receiver, and amplifier a proximity fuze requires an electronic trigger switch (thyratron), an electric detonator, a booster, a power supply, and safety and arming features. Tiny wind-driven generators supplied the power for bomb and rocket fuzes and an ingenious wet reserve battery energized the shell fuzes.

Ruggedness and small size were major design requirements. (*Author's abstract.*)

L. R. HAFSTAD, Johns Hopkins Applied Physics Laboratory: *The development of the radio proximity fuze for shells.*—In research one struggles hard to make apparatus that can work. Before a device can be produced and used in quantity, however, it must be engineered to such a state that it rarely fails. The road from the research stage to a producible item is a long and rocky one, especially if the use required is for military purposes where dependability is a matter of life and death. In the case of the proximity fuze, the pressure for production was so great that there was no time for the usual production engineering stage in the development process. The device went from research to production immediately and such production engineering as was absolutely unavoidable had

to be carried out during the production process itself. As a result of this situation, the procurement problem undertaken jointly by the Navy, the Army, the Johns Hopkins University, and the Bureau of Standards, and the industrial contractors was far from a routine and boring assignment. The problems were many and varied and were soluble only because all parties concerned, military, industrial, and scientific, were imbued with the feeling of the urgency and importance of the overall job. The assignment proved to be an exercise in tolerance and cooperation for all personnel involved.

The quality control problem itself led to the development of new methods and techniques. The proximity fuze production problem was essentially the same as the production on a tremendous scale of extremely high grade radio sets. There was this important difference, however. For ordinary radio sets the product can be bench tested at very frequent intervals along the production line and a final test made just before shipment. In the case of the proximity fuze the final test could be made only under battle conditions months after manufacture. Even the so-called "proving ground acceptance test," usually considered a good measure of quality, proved to be inadequate since it took no account of the extremely elusive quality of "life" in the delicate electronic equipment involved. Furthermore, even with the most vigorous expediting, proving ground firing tests could only be carried out several days after manufacture, so that at a manufacturing rate of 60,000 units per day hundreds of thousands of defective units might be produced before defects could be uncovered by the usual proving ground tests. It was for this reason that a highly specialized "component quality control" program was instituted which proved to be the secret to the solution of the production problem. Every element in the entire unit had to be designed and manufactured with a margin of safety which would insure operation even after months of rough handling in shipment and use. It was the inherent and unavoidable conflict between the demands for quantity and quality that proved to be, throughout the program, an effective guarantee against boredom. (*Author's abstract.*)

Mr. R. J. SEEGER presented an informal communication in which he described visits with certain German scientists during a recent trip to Germany.

1261st Meeting

The 1261st meeting was held in the Cosmos Club Auditorium, February 16, 1946, President DEFANDORF presiding.

Program: R. D. BENNETT, Naval Ordnance Laboratory: *The future of science under government.*—Both applied and "pure" research have been important in the development of our nation since its beginning. In the past the Government has actively sponsored standardization work such as that of the Bureau of Standards, has carried out research in connection with such general services as weather forecasting, has done research for enterprises where units are necessarily small, as in agriculture, but has supported military research only sporadically. The war created great interest in all research but practically stopped the training of scientists. In the competition for trained men the Government can not meet the offers of industry, can no longer appeal so strongly to patriotism, and can not yet offer security as an alternative inducement. To meet these problems, the Advisory Committee on Scientific Personnel (reporting to the Civil Service Commission) is now studying the problems of the employment of scientists by the Government and is sponsoring part-time graduate study by Government employees in the Washington area with gratifying results. The return to permanent appointments, an increase in maximum salaries, and the partial decentralization of classification and employment procedures are now in sight. It is hoped that the present unflattering opinion American scientists have of government employment will be revised when they better understand the problems, aims, and conditions of government research activities. (*Author's abstract.*)

H. L. CURTIS presented an informal communication on a method of measuring curvature of graphs by comparison with standard curvatures on plastic sheets.

1262d Meeting

The 1262d meeting was held in the Cosmos Club Auditorium, March 2, 1946, President DEFANDORF presiding.

Program: R. M. PAGE, Naval Research Laboratory: *Radar, its past and its future.*

Mr. F. C. BRECKENRIDGE presented an informal communication on *Some questions, pertinent and impertinent, concerning the equivalence of matter and energy.*

1263d Meeting

The 1263d meeting was held in the Cosmos Club Auditorium, March 16, 1946, President DEFANDORF presiding.

Program: W. J. HUMPHREYS: *The Philosophical Society in its youth.*—George Washington, Thomas Jefferson, and other intellectual worthies of their day, men of broad vision and clear outlook, urged that there be founded in the Nation's Capital a comprehensive scientific society for the promotion of useful knowledge and its prompt diffusion to all the world.

They had in mind the incalculable benefits to humanity that, directly and indirectly, continuously were coming from the French Academy, the Royal Society of London, the American Academy of Arts and Sciences, the American Philosophical Society, founded by Franklin, before which at one of its meetings Jefferson founded the American branch of an important science, and at another gave a mathematical paper of the utmost economic value. Let there then, they urged, be such an organization in Washington.

For many years nothing of importance came of these and often repeated similar suggestions and convincing arguments by those who saw the light and wanted to follow it. At last, however, on March 13, 1871, the end they so earnestly desired was attained by the founding of the Washington Philosophical Society, with a creative scholar of all-inclusive scientific interest for its president—Joseph Henry, Secretary of the Smithsonian Institution.

At first the Philosophical Society covered all sciences but provided for the friendly separation of special groups whose interests were more narrowly restricted. Such groups were formed until now there are about a score of them in Washington, each speaking a jargon of its own, but for all that doing much valuable work. In the meantime the parent society continued its unbroken course of growth in membership and increase of importance.

Among the early members of the Society were: Joseph Henry, its first president and a physicist of the highest rank; Simon Newcomb, a mathematical astronomer of world-wide recognition and second to none of his day; Jonathan Homer Lane, who attained scientific immortality by proving that the more heat a star loses the hotter it gets; Alexander Graham Bell, of telephone fame, whose Wednesday evenings at home were memorable occasions to Washington scientists; William Ferrel, who proved that in the Northern Hemisphere air pushed north blows eastward, pushed east blows southward, and so on around the compass; Samuel Pierpont Langley, who with his bolometer pushed our knowledge of the solar spectrum far beyond the limit of vision or range of the photographic plate; and many others, including two of America's most noted scientists, T. C. Mendenhall and C. D. Walcott, each a president of this Society, who never had a day's training at college.

These were only some of the many great scientists who were members of the Philosophical Society—too great ever to act snobbish.

For a long while after the founding of the Society many, if not nearly all, of its more eminent members wore full beards. Why they did so I do not know; perhaps they were frank enough openly to admit that shaving is a nuisance.

For 40 years or so after its founding the meetings of the Society were rather formal and dignified, in keeping with the customs of cultured gentlemen on any important occasion. Always shirt sleeves were out of order, and smoking was strictly taboo, not by virtue of any formal rule or bylaw, but through the then universally recognized courtesy of one gentleman to another. However, the things that more than all others characterized the Society in its early days, and still characterize it, were its desire for useful knowledge and its respect for those who contribute thereto. (*Author's abstract.*)

I. C. GARDNER, National Bureau of Standards: *Scientific and technical development of the German optical industry during the war.*—The speaker presented the results of a three-months' trip to Germany during which the different optical firms were visited and their scientific personnel interviewed. The investigation was made under the sponsorship of Army

Ordnance. After a brief review of the general organization of the optical industry in Germany, the production of optical glass, the methods for producing reduced-reflection coatings, the production of fused quartz of optical quality, the growing of crystals for optical purposes, and the construction of optical instruments were discussed in some detail. Stereopticon slides were presented showing the different types of machines in use in the Zeiss plant. Slides of general interest presenting the conditions of present day Germany were also shown. (*Author's abstract.*)

In an informal communication Mr. W. J. HUMPHREYS suggested that mirages may have given rise to the Biblical report of the parting of the waters of the Red Sea (see Sci. Monthly **63**: 82. 1946).

1264th Meeting

The 1264th meeting was held in the Cosmos Club Auditorium, March 30, 1946, President DEFANDORF presiding.

Program: E. K. PLYLER, National Bureau of Standards: *Applications of infra-red spectrometry to chemical analyses and molecular problems.* —On account of the war, infrared work has increased greatly. There have been developed better methods of detecting infrared radiation and instruments are now being made which are almost automatic in operation. A slit control device is described which keeps the total energy practically constant from 3 microns to 14 microns. Results are given for the percent transmission of 20 hydrocarbons. Marked changes produced in the absorption spectra by isomers are well illustrated in this set of spectra. (*Author's abstract.*)

F. WENNER, Department of Terrestrial Magnetism: *Forces between linear circuits according to O'Rahilly.*—This paper was published in this JOURNAL (**36**: 294–296. 1946).

In an informal communication Mr. K. L. SHERMAN pointed out that the power required to "create" electrons with their rest energy and at a rate which would maintain the Earth's charge was equivalent to the power dissipated in the atmosphere due to the loss of charge from the Earth during fair weather.

1265th Meeting

The 1265th meeting was held in the Cosmos Club Auditorium, April 13, 1946, President DEFANDORF presiding.

Program: F. J. BRADY, National Institute of Health: *Radioactive antimony in medicine.*— Considerable impetus was given to the study of antimony compounds in medicine because of their usefulness in treating two tropical diseases acquired by members of the armed forces. Collaborative work was carried on by four groups within the National Institute of Health, the Carnegie Institution of Washington, and the U. S. Army. Many new compounds were prepared and tested against the dog heartworm, a parasite related to one of man's parasites. All trivalent antimonials tested eliminated the microfilariae from the blood but the adult parasites were rarely killed. Histologic examination of these adults revealed that degenerative changes of the ovaries and uterus had occurred resulting in sterility of the females.

Radioactive isotopes of antimony were prepared for tracer studies. In dogs, it was shown that the blood antimony concentration falls rapidly after administration of the drug, most of the antimony being taken up by the liver. The thyroid and adult parasites also concentrated the antimony. The excretion rate was low, 4 to 21 percent of the antimony being excreted in 36 hours. In white rats the blood-concentration curve showed a secondary rise beginning between four and eight hours and reaching levels never observed in dogs. Human volunteers were treated with radioactive tartar emetic, and the blood concentration was found to be like that of dogs. A mathematical analysis of these data along with excretion rates indicated that a new compound is formed and probably no antimony in the blood and excretions is tartar emetic after six hours. The indications are that this new compound is less toxic than tartar emetic, that it is more readily mobilized and excreted than tartar emetic, and that most of it is produced in the liver. (*Author's abstract.*)

In an informal communication Mr. F. B. SILSBEE showed slides of the characteristic discharge in a positive electric field in air occurring at one end of a wire simultaneously with the discharge in a negative field at the other end.

In response to a written request for information from an unidentified individual, Mr. L. B.

TUCKERMAN presented an informal communication on the concept of a straight line.

1266th Meeting

The 1266th meeting was held in the Cosmos Club Auditorium, April 27, 1946, President DEFANDORF presiding.

Program: W. F. FOSHAG, U. S. National Museum: *The Parícutin volcano's first year.*—The development of Parícutin volcano from the second day of its existence through the destruction of San Juan Parangaricutiro was shown in kodachrome motion pictures. Parícutin Volcano broke out in a cornfield on February 20, 1943, and rapidly grew to a cone 435 meters high. After a two-week period of local earthquakes and subterranean noise a narrow crack appeared in the soil, from which issued a thin column of steam. A few hours later, the volcano threw volcanic bombs over an area of a mile in radius and began to build its cone. The first month's activity was spent largely in the ejecting of bombs and coarse material, later followed by heavy ash falls. The first lava flow began within two days after the volcano's birth. The lava flows are basaltic and very viscous, advancing at a rate of 1 to 30 meters per hour. A subsidiary cone, Zapicho, formed in October 1943 and continued in activity for about $2\frac{1}{2}$ months. The action of the lava flows, lava fountains, fumaroles, hornitos, and other volcanic features as well as the volcano's effects on life in the area were shown. Included were some views of the interior of the crater during eruption and of the destruction of San Juan Parangaricutiro. (*Author's abstract.*)

1267th Meeting

The 1267th meeting was held in the Cosmos Club Auditorium, May 11, 1946, President DEFANDORF presiding.

Program: Four papers on *Interior ballistics measurements.* H. L. CURTIS, National Bureau of Standards: *Method of recording.*—The measurement of a ballistic quantity such as powder pressure, gas temperature, projectile motion, etc., is accomplished by causing it to produce a change in an electric circuit which will deflect the spot of a cathode-ray oscillograph. The deflection is recorded on a rapidly moving film by photographing this oscillograph spot. The velocity of the film is determined from a short square-wave signal introduced in the record of a temperature-compensated tuning fork. The cross hair of the measuring microscope can be accurately set between the two parallel lines of this signal. All events are measured in the same time scale by having on every trace the record of some event, such as the ejection of the projectile. The magnitude of each quantity measured is shown by a deflection, perpendicular to the motion of the film, of the oscillograph spot. If the deflection is proportional to the quantity being measured, the value of the quantity at any instant is obtained from the deflection and the instrumental calibrations. If the deflections occur only when the quantity passes certain values, the record is in the form of a series of steps which give the time at which the value was reached. (*Author's abstract.*)

C. MOON, National Bureau of Standards: *Measurement of pressure.*—The equipment for measuring the pressure of the powder gases consisted of a pressure sensitive element, called a gage, with recording apparatus. The gages were screwed into holes tapped into the gun tube at several positions along the bore. The recording equipment which consisted of a cathode ray oscilloscope with a drum camera was placed in the laboratory and connected to the gage by a 75-foot length of shielded cable. Three different types of gages were used: Piezo-electric, spring, and resistance-strain.

The piezo-electric gages, which were designed by Mr. H. S. Roberts, of the Geophysical Laboratory of the Carnegie Institution, were highly satisfactory. The spring type gage was designed and used by Drs. H. L. Curtis and R. C. Duncan for measuring pressures in 14-inch guns during the first World War. The natural frequency of this gage was too low for use in 3-inch guns.

Two forms of resistance-strain gages were developed; one a tubular type with a bifilar winding of one mil advance wire which was placed on the outside of the tube, the other a piston type with a grid winding on the shank of the piston rod.

Such excellent agreement was obtained between pressure curves from the piezo-electric gages and the resistance gages that after a time resistance gages only were used since they were easier to construct and maintain.

The accuracy of the pressure measurements is difficult to evaluate. The gages are constant over long periods to better than 1 percent. Errors in pressure obtained are introduced by the amplifiers, and other sources, so that the final pressure may be in error by 2 percent. (*Author's abstract.*)

H. S. ROBERTS, Geophysical Laboratory: *Motion of projectile.*—Several methods are available which give a record of displacement versus time as the projectile travels through the gun barrel. The microwave interferometer, developed by Dr. T. H. Johnson at Aberdeen Proving Ground, is perhaps the most satisfactory. A beam of centimeter wavelength electromagnetic radiation is directed across the muzzle from a radiator to an identical receiver. Part of the radiation enters the gun, travels down to the projectile, is reflected by the projectile, and returns to the muzzle where it combines with the direct beam. The resulting signal is recorded by an oscillograph and exhibits a series of maxima and minima which correspond to definite positions of the projectile. The radiation wavelength should be between 35 and 40 percent greater than the diameter of the bore. The talk was illustrated with oscillograms and displacement-time curves obtained with a 3-inch and with a 37-mm gun. (*Author's abstract.*)

F. C. KRACEK, Geophysical Laboratory: *Measurement of gas temperature.*—The gas evolved in the burning of propellants in closed chambers or guns, if it did no work, and if there were no thermal losses, would be produced at the adiabatic temperature T_0 of the particular chemical reaction involved in the burning process. In the actual burning adiabatic conditions are not strictly fulfilled, and hence the temperature of the gas is always lower than the adiabatic. Furthermore, the temperature varies during the expansion when the gas does external work, and in addition, it may be expected to fluctuate owing to ignition and burning irregularities. Since the time of the entire set of events even in large guns is completed in a few milliseconds, it is evident that only a mass-less thermometer could be expected to follow the actual variations of the temperature.

It was found that the temperature could be determined from measurements of the characteristics of the radiation emitted by the gas. At very low gas densities Δ the emitted radiation consists of thermally excited lines and bands descriptive largely of the inorganic constituents of the powder, superimposed upon a weak continuous background. As the density increases the discrete features of the spectrum merge into the increasingly prominent continuum until when the product of $k\Delta l$ exceeds unity, the spectral distribution closely approaches that of a black body at the temperature T of the gas. In the above, l is the length of optical path through the gas, and k is the mass absorption coefficient which was found to be of the order of 30 to 120 cm^2/gm for the types of powder gas studied.

In making the determinations, the radiation was measured through fused quartz windows by photoelectric tubes of selected spectral response, incorporated into suitable circuits for oscillographic recording. The circuits were described, and data given for measurements taken of the gas temperature in closed chamber and gun firings. (*Author's abstract.*)

KENNETH L. SHERMAN, *Recording Secretary*

Obituaries

E. O. Wooton.—In 1890 there was organized at Mesilla Park near Las Cruces, N. Mex., one of the last Land Grant colleges, first called New Mexico College of Agriculture and Mechanic Arts, later New Mexico State College. Today, with so many successful colleges in the Southwest, it is hard to realize the local importance of this new school, which had no competitors within several hundred miles except the University of New Mexico. The almost fanatical eagerness of people of that region, themselves often barely able to read and write, for better education of their children can be realized only by those who know how they often drudged to educate their sons and daughters. One of the members of the first faculty of this college was Elmer Ottis Wooton, then recently graduated from Earlham College.

The new college began with primitive equipment and a heavy teaching load. Professor Wooton's position for years could scarcely be called a chair of botany, but rather demanded a settee to accommodate the varied subjects he taught. From 1890 until 1911 he had charge not only of botanical instruction and of research in the Experiment Station, but was assigned geology and other subjects. He probably was the last survivor of that first faculty, which was joined only a few years later by that versatile and still active scientist T. D. A. Cockerell.

In the summer of 1892 Professor Wooton made a large collection of plants in the White Mountains of New Mexico, then botanically unknown, and sets of them, distributed to most leading herbaria of the world, have become classical. Sale of the collection enabled him to study at Columbia University from 1896 to 1898, and determine his plants at the New York Botanical Graden. There he was associated with N. L. Britton, P. A. Rydberg, J. K. Small, L. M. Underwood, and E. L. Greene, the last engaged in similar studies of southwestern plants, of which he had been a pioneer collector.

It was here that Professor Wooton began systematic work upon the New Mexican flora, interest in which continued the rest of his life. It culminated in the publication in 1915 by the U. S. National Museum of the *Flora of New Mexico*, in whose preparation the present writer, who had been his student and assistant, cooperated. While this is the volume by which he will be remembered, he published also many articles upon New Mexican plants, particularly cacti, native ornamental plants, and grasses.

Returning to New Mexico in 1898, Wooton was professor of botany until 1900, and professor of biology until 1911, and most students of the college from 1890 to 1911 were in his classes. A born teacher, he possessed an extraordinary talent for lucid and practical instruction that held the interest of a student. His influence was not confined to subjects he was scheduled to teach but extended to other branches of knowledge and culture that for him were quite as important as his official subjects. Both Professor Wooton and his wife were intensely interested in music and the cultivation of its appreciation among the student body.

I do not know what botanical experience he had before settling in New Mexico, but once there, the plant life, so unlike that of Indiana, claimed his attention. He spent his vacations traveling and camping with a team and wagon, gaining a more intimate acquaintance with the country than is possible with an automobile. He visited all parts of New Mexico, some of them repeatedly. It was his duty to inspect grazing lands reserved for support of the college, and thus he took a special interest in range problems, which led to his employment for this type of work in the Department of Agriculture, where he continued the rest of his active life. He held various positions in the Office of Farm Management until his retirement in 1935. During his later years he lived at Arlington, Va., with his daughter Esther, after the death of his wife, whom he married soon after his graduation from Earlham. Professor Wooton was born of Quaker stock at Kokomo, Ind., on September 19, 1865, and died on November 20, 1945.

I believe that Professor Wooton in his late years looked back to his early days in what was then truly Wild West as the happiest time of his life. New Mexico, despite some sterner phases, has a peculiar fascination, based upon

its beautiful mountains and plains, its vast vistas, its romantic history, and its varied population, to which many people have succumbed. It is a local saying that whoever lives three years in New Mexico never leaves, or regrets it ever afterward if he does. It was unfortunate that Professor Wooton did leave the teaching profession, for which he was uncommonly qualified; and good teachers are not common. He will be remembered gratefully by the college that he served so long and so loyally; indeed, it expressed appreciation of his services by the honorary degree of doctor of sciences in 1932. Professor Wooton is held today in affectionate remembrance by hundreds of former students and other friends, who will not forget his infinite patience, his kindness, his shrewd advice, his keen interest in scientific progress, and his gentleness except when his sense of justice was violated.

PAUL C. STANDLEY.

EDWARD ALPHONSO GOLDMAN, one of the outstanding American mammalogists, died suddenly in Washington, D. C., on September 2, 1946. He had been associated in biological work for over 51 years with the Biological Survey and its successor, the U. S. Fish and Wildlife Service.

Goldman was born at Mount Carroll, Ill., on July 7, 1873, but spent most of his childhood in Nebraska and California, where his parents had moved seeking better agricultural opportunities. His education consisted of grade and high-school training and later of collegiate courses fitting his particular calling of naturalist.

On March 1, 1892, when only 18 years of age, Goldman hired out as a personal assistant to Edward W. Nelson, who later became chief of the Biological Survey, and together they formed a friendly scientific partnership that lasted more than 40 years, terminated by Dr. Nelson's death in 1934. Indeed, so close was this association that the names Nelson and Goldman were linked almost inseparably, especially when referring to their natural-history work in Mexico. No two scientists knew Mexico better, for together or singly they spent more than 14 years in this republic, crisscrossing it from north to south and from east to west, studying its fauna and flora, and collecting nearly 23,000 mammal specimens, which are now housed in the Biological Surveys collection in the U. S. National Museum. Many of these specimens have through the years become the types of species and subspecies of North American mammals new to science.

During the more than half a century of Goldman's official connection with the Federal service he held many positions: field naturalist of the Biological Survey (1892–1917), chief of its division of biological investigations (1917–1925), chief of its division of game and bird reservations (1925–1928), senior biologist in its division of wildlife research (1928–1940). He served one and one-half years as a sanitary officer with the rank of major with the American Expeditionary Forces in France during World War I, in charge of rodent-control operations. At the close of the war he became a Reserve Major, Sanitary Corps, for the period 1922 to 1937.

Besides his research and administrative work Goldman become a leading authority in wildlife management. He took a very prominent part in this country's negotiations for what finally become a treaty between the United States and Mexico, on February 7, 1936, for the protection of migratory birds and game mammals. In commending Major Goldman for the part he played in the successful conclusion of the treaty, the American Embassy at Mexico City stated that Major Goldman was recognized by the Mexicans as an authority on Mexican fauna and as one who was more familiar with the subject than were the Mexicans themselves.

Although Major Goldman officially retired in December 1944, when he was appointed honorary associate in zoology on the staff of the Smithsonian Institution, he continued with his work and writings to within a few days of his death. He had hoped to complete his *Mammals of Mexico*, on which he had been working for many years; a part of this is planned for publication. His bibliography covers 206 titles, published over a period of 44 years beginning in 1902, mostly in the field of mammalogy. He was author of three numbers of the Biological Survey's North American Fauna series: *Revision of the wood rats of the genus Neotoma* (1910); *Revision of the spiny pocket mice (genera Heteromys and Liomys)*

(1911); and *Rice rats of North America* (*genus Oryzomys*) (1918). In 1920 the Smithsonian Institution published his *Mammals of Panama*, based on a faunal survey of the Isthmus that he made during the construction of the Panama Canal. He was coauthor, with the undersigned, of *The wolves of North America* (1944) and of *The puma: Mysterious American cat* (1946), both published by the American Wildlife Institute. Though Goldman will always be remembered as one of our greatest authorities on the mammals of North and Middle America, he also excelled in the fields of ornithology and botany. He described well over 300 forms of mammals; and more than 50 birds, mammals, plants, reptiles, and mollusks have been named in his honor.

Major Goldman held membership in the American Association for the Advancement of Science (fellow), the Washington Academy of Sciences, the Biological Society of Washington (past president), the American Ornithologists' Union, the Cosmos Club of Washington, D. C., the Explorers' Club of New York, the Cooper Ornithological Club, the Washington Biologists' Field Club, the Baird Ornithological Club, and the American Society of Mammalogists, of which he became president in April 1946.

Burial with full military honors took place at Arlington National Cemetery on September 6, 1946. Besides his wife, he is survived by three sons, a grandson, and two brothers.

Goldman was a man who will long be remembered for his many human qualities. Modest and unpretentious in all he said and did, he endeared himself to all who knew him. His understanding, generosity, and almost God-like even temperament probably account more than anything else for the fact that so far as known by his associates he never had a single personal enemy.

STANLEY P. YOUNG.

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HISTORY OF SCIENCE.—*An establishment was established.*[1]

EARL S. JOHNSTON, Division of Radiation and Organisms, Smithsonian Institution. (Communicated by H. A. REHDER.)

One of the penalties attached to the presidency of the Botanical Society of Washington is the retiring address. By tradition this address may be on any subject, and at the end no discussion or questions are permitted, only applause. At first, I was tempted to discuss the place of plant physiology in the botanical world and perhaps dwell to some extent on the physiological work of the Division of Radiation and Organisms at the Smithsonian Institution. Then the thought occurred to me that this year is the 100th anniversary of the establishment of this Institution and that I could never again take advantage of such a wonderful opportunity. Because of the Institution's relationship to the development of science in the United States, a few facts and figures connected with its origin are appropriate at this time.

In September 1835, John Forsyth, then Secretary of State, was surprised to receive a dispatch from London enclosing a copy of the will of a man named James Smithson. An accompanying letter stated that the nephew mentioned in the will had died and that the United States was entitled to his estate. Who was James Smithson and why should he leave his estate of £100,000 to the United States of America? These are fitting questions to be asked on this 100th anniversary of the founding of the Smithsonian Institution.

James Smithson was born in France in 1765, spent most of his life in France and Germany, and in 1829 died in Italy, where he was buried. By the terms of his will most of his property was left to his nephew, Henry James Hungerford. The will stated, "Should the said Henry James Hungerford have a child or children, legitimate or illegitimate, I leave to such child or children . . . the whole of my property. . . . In the case of the death of my said Nephew, without leaving a child or children, or the death of the child or children he may have had under the age of twenty-one years or intestate, I then bequeath the whole of my property . . . to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an Establishment for the increase and diffusion of knowledge among men."

James Smithson was the natural son of Sir Hugh Smithson (later the Duke of Northumberland) and Elizabeth Keate Macie, a widow and lineal descendant of Henry VII. As a youth he bore his mother's name, and it was not until fourteen years after graduating from Pembroke College, Oxford, that he adopted the name James Smithson. It was perhaps a feeling of injustice regarding the circumstances of his birth that created in him the desire to perpetuate his name, for in one of the manuscripts he left we find these words: "The best blood of England flows in my veins; on my father's side I am a Northumberland, on my mother's I am related to Kings, but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten."

After graduating from Oxford in 1786, Smithson applied himself to the study of chemistry. He was very skillful in working

[1] Address of the Retiring President of the Botanical Society of Washington, read at the 357th meeting of the Society on December 3, 1946. Received December 20, 1946.

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with small quantities of chemicals. Today we might call him a microchemist. "It is said that he was fond of narrating an incident illustrating this faculty. On a certain occasion he happened to observe a lady crying, and hastily taking out a small crystal vessel, he seized the opportunity to catch one of the teardrops in the hope of analyzing it and although half of the precious drop escaped, he succeeded in detecting in the other half not only appreciable amounts of muriate of soda but also the compound of phosphorus known at that time as microcosmic salt, and certain other saline substances."

Smithson was admitted to membership in the Royal Society of London in 1787, less than one year after his graduation from Oxford, one of his sponsors being the famous Henry Cavendish, discoverer of hydrogen. At least 27 of his scientific works were published between 1791 and 1825, all but two relating to chemistry and mineralogy. It may be of interest to botanists to know that one of the two was entitled "An Improved Method of Making Coffee." Another was entitled "On a Substance from the Elm Tree, Called Ulmin"; another, "A Few Facts Relative to the Coloring Matters of Some Vegetables." His writings were well received by his fellow scientists, and he was held in high esteem not only in England but abroad. His publications reflected the influence of his extensive travels in Europe, which gave to them a cosmopolitan flavor. He seemed to realize in his day that science knows no national boundary but is universal for all mankind.

It is interesting to examine in the light of history the complicated chain reaction started by the well-meaning sentiment of a far-sighted Englishman as expressed in his bequest to the United States. Three months after receiving word of this bequest, President Jackson presented the matter to Congress. This, of course, started a pro and con discussion. Senator Calhoun of South Carolina considered it "beneath the dignity of the United States to receive presents of this kind from anyone." Others argued in its favor, and finally the Senate by a 31 to 7 vote decided to prosecute the claim.

The man selected to present this claim in the English Court of Chancery was Richard Rush, the son of Dr. Benjamin Rush, of Pennsylvania. He had been both Comptroller of the Treasury and Secretary of the Treasury, positions that made him particularly well qualified for the work. Dr. Rush, years before, had done all he could to discourage his son from going into Government service but to no avail. He set down in writing his several reasons which in the light of firsthand knowledge of many of us are just as interesting today as they were in 1811:

"1st. The degradation to which such an office exposed a man of literary and professional talents. It was an office that could be filled by any clerk of a bank.

"2nd. The vexations and poverty of political life.

"3rd. His comfortable establishment and excellent prospects in Pennsylvania, the State of his ancestors and family.

"4th. The sickliness of Washington and the insufficiency of the salary to support a growing family.

"5th. The dishonor which he would do to his understanding by such an act.

"6th. My age, also my young family, which required his advice now and would still more require it after my death. I offered to implore him not to accept of the appointment upon my knees, but all, all to no purpose."

On a salary of $3,000 and an allowance of $2,000 Richard Rush secured a bond for $500,000 and set out for England, arriving there the last of August, 1836. The decree adjudging the Smithson bequest to the United States was pronounced on the 9th of May, 1838, in less than two years. In view of the difficulties encountered and the sluggishness of the Court this was quick action. A "moral claim" was entered by the mother of young Hungerford. She urged that the "increase and diffusion of knowledge among men" begin with the education of her children. Mr. Rush settled for £150 a year during her lifetime. Immediately following the publication of the court decree, two men, in no way connected with each other, appeared for claims and were much

surprised to learn that the case was closed and could not be opened.

Mr. Rush had the entire Smithson estate converted into cash and then changed this into gold for transportation to the United States. With the bags of gold safely stored in the hold of the packet *Mediator*, he set out for New York on July 17, 1838. On landing, Mr. Rush received word to deposit the money in the mint at Philadelphia. This he did on September 1 by taking a stage into which he loaded the 105 bags of gold sovereigns. The receipt given to him by the Director of the Mint was for $508,318.46, and I can imagine he breathed a huge sigh of relief.

The Secretary of the Treasury invested the funds in State stocks, mainly in Arkansas, at 6 percent interest. This State having failed to pay its interest in 1846, Congress made good the deficiency and has since paid annually the interest at 6 percent on $538,000, the amount at the time the Arkansas investment was made.

On December 6, 1838, President Van Buren informed Congress that the legacy of Smithson had been received and asked them to proceed toward carrying out the object of the bequest. It took Congress eight years to agree upon a definite plan of organization. Opinions varied greatly as to the best method of increasing and diffusing knowledge among men. Among the ideas put forth were to found:

A great university
An agricultural school and farm
Instruction of females
Courses of lectures
School for the blind

John Quincy Adams, chairman of the House Committee, appointed to handle the matter favored an astronomical observatory. There is no particular reason for a detailed review of the discussions and debates that took place. Each year the President (Van Buren, Harrison, and Polk in succession) urged immediate action. Some benefit, however, was derived from these extended discussions. Congress was enlightened and public opinion molded. Finally a bill establishing the Smithsonian Institution was passed, and on August 10, 1846, it was signed by President James K. Polk. Congress could now resume such matters as the Oregon question and a war with Mexico.

A Board of Regents was soon appointed and the organization of the Institution rapidly took form. Careful consideration was given to the appointment of its first Secretary. Their choice of Joseph Henry, of Princeton, N. J., was most fortunate. Not only was he America's leading scientist but also, as later years proved, a most capable administrator. His program to carry out Smithson's instructions have in general been followed to this day. Congress, then as often in later years was more interested in physical impressions of size, utility, and grandeur. Henry stuck to his convictions, as may be seen from his report, "If physical well-being were alone the object of existence, every avenue of enjoyment should be explored to its utmost extent. But he who loves truth for its own sake, feels that its highest claims are lowered and its moral influence marred by being continually summoned to the bar of immediate and palpable utility."

Secretary Henry realized that the funds at his disposal could easily be exhausted if many projects for the increase of knowledge were undertaken directly by the Institution. His policy of helping others with grants-in-aid and other forms of fostering research far surpassed anything that the Smithsonian could do by itself. Thus a large amount of scientific knowledge was built up in the country in various institutions of learning, and each of these became the center from which new knowledge was diffused. It was Henry's suggestion that the Institution support telegraphic weather data reports, and this work eventually resulted in the establishment of the United States Weather Bureau.

One of Henry's original policies was to establish a system for the "diffusion of knowledge." The International Exchange was established whereby books and documents could be sent duty free to and from other countries through the Smithsonian Institution.

Henry helped to organize the American

Association for the Advancement of Science, and there has always existed a close bond of friendship between it and the Smithsonian Institution. Only this year the Association has moved to its new headquarters after outgrowing its long-occupied home in the Smithsonian Building.

The forerunner of the United States National Museum appears to have been the National Institution for the Promotion of Science, organized in Washington on May 15, 1840. As stated by George Brown Goode, "The establishment of this society was doubtless to a very large degree due to the stimulating and inspiring effects upon public opinion of the Smithson bequest. The germs of the idea which it represented seem, however, to have existed in Washington at a much earlier period, for in 1816, or before, a similar society had been organized in the capital under the name of 'The Columbian Institute for the Promotion of Arts and Sciences'."

For almost 18 years the National Institution was the official custodian of the nation's museum materials and of the collection of Smithson's books, manuscripts, and minerals. Goode further states:

> The influence of the National Institute upon the history of science in the United States, and particularly in educating public opinion and the judgment of Congress to an application of the proper means of disposing of the Smithsonian legacy, can not well be overestimated.
>
> If the Smithsonian had been organized before the National Institute had exerted its influences, it would have been a school, an observatory, or an agricultural experiment station.
>
> The formation of a "national museum" was one of the professed objects of Poinsett and his associates in the National Institution, but it does not appear that they ever dignified with that name their collections, which were usually modestly referred to as constituting the "cabinet" of the Institution, both in the constitution and in the proceedings of the society.

From 1847 to 1851, however, there was no use made of the term National Museum, the collections of natural history which were accumulating under the care of Professor Baird constituting for the time being the "Museum of the Smithsonian Institution."

The National Cabinet of Curiosities (the collection in the Patent Office), carrying with it a certain official atmosphere, as well as an annual appropriation, was, however, one of the parents of the greater establishment yet to come. Of its marriage with the Smithsonian Museum, the National Museum of the United States was the offspring.

In 1857, the Smithsonian Institution having definitely accepted the responsibility of caring for the national collections, all the articles deposited with the National Institute were removed.

Among the objects transferred to the Smithsonian Building were James Smithson's valuable collection of several thousand minerals and his books, pamphlets, and manuscripts. Unfortunately, most of these were lost in the fire in the Smithsonian Building of 1865.

To members of the Botanical Society of Washington the best-known collection added to the museum is the U. S. National Herbarium housed in the Smithsonian Building. From a nucleus of plants collected by the Wilkes Exploring Expedition from 1838 to 1842 this collection has grown to nearly two million specimens. Qualified students may avail themselves of the splendid opportunity to study these collections from many parts of the world. I know of no better way of concluding this condensed discussion of the beginnings of the Smithsonian Institution than by referring to the opportunities for research that the National Herbarium offers to botanists.

ARCHEOLOGY.—*A Middle Period cemetery in the Virú Valley, northern Peru.*[1]

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During a major portion of the year 1946, the present author, accompanied by various colleagues of the Institute of Andean Research, conducted archeological investigations in the Virú Valley on the north coast of Peru. Although primarily engaged in a study of prehistoric settlement patterns as they are found in Virú, he was able, in addition, to make a number of minor excavations. The opening of a series of graves in a cemetery, known only by the Virú survey designation as *site V-142*, was one of these subsidiary operations. The graves and their contents are described in this paper.

THE SITE

The Virú River is one of the smaller streams of the Pacific watershed which creates a small oasis valley on its way to the sea. Today its valley is cultivated for a distance of about 30 kilometers from the delta inland and, at its widest point, for about 6 kilometers across the valley. In the upper reaches of the Huacapongo, the principal tributary to the Virú, the modern cultivated strip along the river is no more than a kilometer wide. The lower two-thirds of the valley is bordered, for the most part, by the flat, gradually rising plains of the coastal desert, but in the upper one-third the narrow bottomlands lie between walls of rocky mountainous hills, the lower foothills of the Andean massif.

The cemetery site, *V-142*, is in this upper one-third of the valley, in the Huacapongo branch, on the north side of the river bottom. (Its location is at latitude 8° 22′ 40″ S., longitude 78° 41′ 8″ W.) It is situated on a sloping boulder-strewn alluvial fan that extends down out of a quebrada in the bordering hills. The alluvial deposit is typical of the valley margin in its upper zone. The rare but heavy rains of the coast carry tons of rock and gravel from the hills toward the drainages. *V-142* is on an old section of the fan that has not been washed out or covered by more recent alluvial action. Immediately to the east and west of the cemetery site there are evidences of recent (in terms of human occupation) floodings, which have cut away sections of the old fan, together with portions of the archeological features, probably including the cemetery. Present-day cultivated areas are confined to the actual valley bottom, which lies 200 to 300 meters downslope from the site. It is clear, though, from evidences of ancient irrigation works that in prehistoric times the now abandoned alluvial fans were cultivated. The *V-142* cemetery lies in the midst of archeological communities, canal systems, walls, and mounds.

The surface of the cemetery looks like any other open area on the rocky fan. There are no surface features that can be definitely correlated with the burials. The presence of graves was indicated by old diggings revealing large sherds, human bone fragments, and other evidences around the open grave pits. The site is, incidentally, marked by two surface features not necessarily characterizing it as a cemetery. One of these is a section of an old, partially destroyed defense wall. This wall is made of boulders, is about 1 meter wide, and still stands about a meter or so high. It is probably part of a continuous system of walls that generally run parallel to the valley and were connected with some prehistoric phase of occupation of the alluvial fans. It may either antedate or postdate the burials of the cemetery. The other feature is a small rocky knoll lying just to the south of the wall section. This mound rises between 1 and 2 meters above the surrounding ground level and has dimensions of about 10 by 20 meters; its summit is dotted with old grave excavations. It is probably an artificial construction, quite likely a house or temple mound of a preceding period into which the later interments were made.

In all, the area of the graves at *V-142*, including the mound, can be encompassed within a radius of 35 to 40 meters from a central point on the wall. Graves were located by us on both the north and south sides of the wall.

[1] Received December 10, 1946.

GRAVE EXCAVATIONS

Apparently burials had been made without any plan of arrangement. All graves were merely holes in the rocky soil without special lining, flooring, roofing, or distinctive form. In depth they ranged from about one-half meter to 2 meters. As nearly as could be determined it seemed as though the original grave pit had been roughly circular and relatively narrow (1 meter or less). Twelve graves, in all, were opened in a period of a few days during June.

Grave 1. In dust and boulders at a depth of slightly over 1 meter. No identifiable human skeletal material found.

One globular jar (211-1)[2] was recovered. Height 17.2 cm and diameter 19 cm. Has rounded base and cambered collar with sharp angle. Ware is coarse and mottled gray-black. On the collar are appliqué semicircular nodes, each of which has been impressed with vertically placed incisions. On shoulder, just below collar, are two fillet strips which almost meet at opposite sides of vessel. These strips are also impressed with similar incisions.

Grave 2. Located 1 meter from *Grave 1.* Pottery vessels were first encountered at depth of 85 cm. A few badly disintegrated human bone fragments came from a depth of 1.00 to 1.25 meters. Other vessels were found below this to depth of 1.50 meters. Eight pottery vessels were recovered.

Drum-shaped vessel (213-1) (Fig. 1, j). Height 31 cm, length 33.5 cm, width 21 cm. Has outflared spout or collar. Ends of vessel or drum are flattened but bulging. Body is barrel-like or cylindrical with expanded center. There is a little loop handle parallel to the long axis of the vessel at the base of the collar. Ware is polished black. Pressed design covers one end of barrel. Central element of design is a plain circle to which are attached 8 radiating rays. Four rays are pointed, star-fashion; four others tend to expand toward end. The whole is enclosed in a circle. On opposite end is a frog effigy in relief, affixed to top of vessel facing in toward the collar. Frog lies prone with legs outstretched. Eyes are done with appliqué pellets and back and feet with punctations.

[2] Numbers listed are temporary field catalogue numbers for Institute of Andean Research 1946 season in Peru.

Drum-shaped vessel (213-2). Height 33.5 cm, length 42 cm; width 26 cm. Very similar to 213-1. At base of collar is small rounded ridge. On opposite sides of collar are two tiny nubbins attached to the ridge. No other decoration. Ware polished black.

Plain jar or olla (213-3). Height 29 cm, diameter at midpoint 31 cm. Collar markedly flaring. Rounded base. Polished black.

Plain jar or olla (213-4). Height 21 cm, diameter at midpoint 24.5 cm. Short cambered collar with ridge. Polished black.

Globular jar (213-5). Height 17 cm, diameter at midpoint 17.5 cm. Rounded base, short everted collar. Gray-black, coarse ware. On one side of vessel just below collar are 2 small buttonlike nodes.

Globular bottle (213-6). Height 21.2 cm, diameter 20 cm at midpoint or slightly below. Narrow mouth and long neck. Neck has basal bulge, is constricted at midpoint, and rim is cambered. Gray-black ware with no slip or polish. Appliqué strip encircles shoulder. This strip marked with crisscross incisions.

Globular bottle (213-7). Height 14.7 cm, diameter at midpoint 14.5 cm. Flat circular base, long, slightly outflared spout. Black polished ware. Five evenly spaced nodes project from sides of vessel body.

Stirrup-spout jar (213-8) (Fig. 1, f). Height 24 cm, base 12.7 by 8.1 cm. Lower part of vessel is rectangular box upon which reclines the sculptured figure of a female animal. Unfortunately the head has been broken off. Spout attached to animal's shoulder and hip. Loop of spout is squared in cross section and upper spout is tubular, straight, with thin tapered lip. Small modeled monkey is placed at juncture of spout and loop in classic fashion.

Grave 3. Remains of three human skeletons were found in this grave, in dust and boulders at a depth of 1.00 to 1.20 meters. Associated with an infant were:

Globular jar or olla (428-1). Height and diameter 18.5 cm. Base rounded, collar cambered. Reddish-tan ware without slip.

Small globular jar (428-2). Height 11.5 cm, diameter at midpoint 12 cm. Cambered collar. Gray-black ware with no slip or polish.

Associated with skeletal material unidentifiable as to age or sex was: Globular jar (429). Height 16.5 cm, diameter 18 cm. Slightly flattened base, short, cambered collar with very



FIG. 1.—Pottery vessels and stone artifact from *V-142* cemetery, Virú Valley, northern Peru: *a*, 219-3, Grave 8; *b*, 219-2, Grave 8; *c*, 218-1, Grave 7; *d*, 219-1, Grave 8; *e*, 220-1, Grave 9; *f*, 213-8, Grave 2; *g*, 437-3, Grave 12; *h*, 218-3, Grave 7; *i*, 430, Grave 4; *j*, 213-1, Grave 2.

sharp angle. Gray-black, unpolished, unslipped ware. On opposite sides of vessel, on shoulder, are two appliqué strips placed vertically. These have been indented with close-spaced impressions.

The third skeleton, probably that of an adult, had no associations.

Grave 4. Remains of a child (bone fragments only) at depth of about 1 meter in dust and rock. One pottery vessel was associated.

Pitcher (430) (Fig. 1, i). Height 20 cm, diameter slightly below midpoint 16 cm. Has two nubbin handles at juncture of spout and body. Each of these perforated with small hole. Base slightly flattened, body angle rounded. Gray, unslipped ware with reddish (oxidized) spots. Band of decoration on bulged area at juncture of body and spout. Fine dentated-incised technique (may be shell-edge stamping). Incised horizontal zone within which are diagonally placed incised lines.

Grave 5. Remains of a child (bone fragments only) at depth of about a meter in dust and rock. One pottery vessel in association.

Globular jar (431). Height 19.5 cm, diameter below midpoint 20.5 cm. Short cambered collar with marked shoulder angle. Gray-black, unslipped ware. Six pellet applications on shoulder each of which has been punched with hollow-reed.

Grave 6. Burial of small child at depth of 50 cm in dust and boulders. Four vessels were associated in addition to some beads and copper ornaments.

Miniature jar (217-1). Height 7.8 cm, diameter below midpoint 7.8 cm. Badly made. Two small loop handles placed vertically at collar-body juncture. Flattened base. Black, unslipped ware.

Miniature jar (217-2). Height 7.5 cm, diameter below midpoint 7.7 cm. Long neck, outflared collar, two small poorly made handles vertically placed on shoulders. Whole vessel poorly made. Black unslipped or unpolished ware. Crisscross incised design on shoulders.

Globular jar (217-3). Height 20 cm, diameter at midpoint 20.5 cm. Slightly flattened base, short cambered collar. Coarse gray-black ware with reddish fire spots. Six evenly spaced appliqué buttons on shoulder each of which has been punched with broad, deep, vertically arranged indentations.

Globular jar (217-4). Height 15 cm, diameter at midpoint 17 cm. Short cambered collar with marked ridge. Polished black ware with soot-caked base. Slovenly incised band of decoration around shoulder which consists of crosshatched elements. There are two vertically placed lugs on opposite sides of vessel within the zone of decoration.

In addition, (217-5), 2 small twisted sheets of copper, 1 small copper bead, 1 copper spindle whorl, 1 large stone bead, 2 conical pottery beads, and about 50 tiny brown and white beads of stone.

Grave 7. Grave of a child at a depth of 80 cm in dust and rock. Three vessels were found.

Bottle or jar (218-1) (Fig. 1, c). Height 12 cm, diameter below midpoint 13 cm. Partial plant or vegetable effigy. Virtually straight neck. Base flattened. On one side of body is curved, stemlike projection, obviously in imitation of a plant. Stem-end detail has been modeled and applied separately. Stem has been covered with small, flat appliqué nodes. Black ware showing some polishing striations.

Miniature globular jar (218-2). Height 7 cm, diameter at midpoint 8 cm. Two small loop handles are vertically placed at neck, and each handle has two small protuberances. High collar, outflared lip. Gray-brown ware, heavily sooted.

Globular jar (218-3) (Fig. 1, h). Height 16 cm, diameter just below midpoint 16.2 cm. Markedly outflared collar. Redware (firing color) without polish. On shoulder are 10 appliqué pellets.

Grave 8. Burial of individual unidentifiable as to age or sex. Located about 58 meters south of the wall section. This grave and *Grave 12* were the only two that were found at a considerable distance from the wall and from the other graves. In this location there is much less loose rock, much more abundant earth soil. Grave was 1.75 meters deep. Three pottery vessels and some miscellaneous copper fragments were recovered.

Double vessel, plant effigy (219-1) (Fig. 1, d). Height 16 cm. Two spouts and flat bridge handle. Composed of two gourds joined by connecting tube. Gourds placed in opposing fashion so that curled stem ends are on opposite sides of vessel. Each gourd has annular pedestal base. Spouts long and tapered. Natural ware color is orange, but this had been covered with white slip and painted black and

red. Red running scroll designs can be vaguely made out despite erosion of surface. Two little modeled birds are perched on the bridge handle.

Globular jar (219-2) (Fig. 1, b). Height 15.7 cm, diameter at shoulder 18 cm. Collar cambered and rounded in profile. High shoulder. Coarse unslipped redware, somewhat blackened by soot. Pressed design on shoulder in band encircling vessel consists of slightly diagonal rows of nodes. These rows may be single, double, or triple. Give vague effect of ears of corn.

Pitcher (219-3) (Fig. 1, a). Height approximately 21 cm, diameter at midpoint 16 cm. Thin, fine sand-tempered ware, buff-red. Appears to have been covered with chalky white slip. Upper half of vessel has, however, been white-slipped in a more solid tone. Horizontal band decoration in red and black on white ground. Black used to outline design and red as filler. Horizontal zone divided into vertical panels. Wavy lines used as fillers in these panels. There are two little nubbin handles on opposite sides of the base of spout.

Two lumps of copper (219-4) about 2 to 4 cm in diameter and 7 mm in thickness. Preserved fragments of string attached.

Grave 9. Fragments of human skeleton located at 50 cm below surface in rock and dust. One vessel associated.

Globular jar (220). Height 21 cm, diameter at midpoint 20 cm. Cambered collar. Coarse gray-black ware heavily sooted. Two horizontally placed appliqué strips on opposite sides of body just below collar. These have been heavily indented with vertically placed impressions or punctations.

Grave 10. Burial of child at depth of 2 meters in dust and amidst large boulders. One vessel associated.

Small globular jar (432). Height 11.2 cm, diameter slightly above midpoint 13 cm. Cambered collar. Redware with soot stains. Pressed decoration in band encircling vessel above shoulder. Design composed of three rows of raised dots enclosed by a single line above and one below.

Grave 11. Burial of child in 60 cm of rocks and dust. One vessel in association.

Pitcher (433). Height 20 cm, diameter between 15 and 13 cm. Vessel slightly flattened in vertical plane. Spout slightly outflared. Slight bulge at collar-body juncture. Gray-black unslipped ware. On shoulders are opposing pairs of nodes. Each node is punctated in center with small round dot.

Grave 12. This grave is located some 60 meters south of the wall, about 2 meters from *Grave 8.* A poorly preserved adult skeleton was found at a depth of 1.50 meters in dust but with little rock. A single vessel, some copper fragments, and a carved stone object were found in association.

Globular jar (437-1). Height 17.5 cm, diameter above midpoint at high, angled shoulder 19 cm. Short cambered collar. Coarse redware caked with soot. There is a small horizontal flange on one side of the rim which has a tiny hollow-reed punctation on its upper side. Pressed zone of decoration above the shoulder angle is a band divided by sets of double vertical lines. There are four panels, each of which contains a field of relief nubbins in three or four horizontal rows.

Two heavy pieces of copper (437-2) which appear to be rough-pounded disks with fragments of string adhering. Diameters 4 and 2.5 cm and thickness about 3 mm.

Stone estolica hook (437-3) (Fig. 1, g). Length 7 cm, width 2.9 cm, thickness 1.7 cm. Carved of a blue-gray stone to represent what appears to be an ear of corn.

DISCUSSION

The *V-142* collection of grave ceramics falls into four main descriptive categories: (1) black ware or gray-black ware; (2) a painted Black-white-red ware; (3) coarse red-fired ware; (4) and a polished orange ware. Out of a total number of 28 vessels there are 13 coarse gray-black, 7 polished black, 5 coarse red, 2 Black-white-red, and 1 polished orange. As a group the collection appears, at first glance, to be representative of the latter part of the Middle Period of the Peruvian north-coast culture sequence. This is the temporal subdivision that Bennett (1939, pp. 140–142, 146–147), with reference to the entire Virú-Moche-Chicama sector, has designated as "Middle Moche II, Sub-period C." He characterizes this particular time bracket by a north-coast variant of the widespread Black-white-red geometric ceramic style, numerically high

percentages of black ware, pressed decoration, absence of architectural features in association with graves, well-preserved cloth, and the frequent presence of copper artifacts with burials. As a subperiod he has distinguished it on a grave and site association basis from the Epigonal or Coast Tiahuanaco style, its apparent predecessor. This distinction in the north gains additional support from the chronological split between Epigonal and the Black-white-red geometric on the Peruvian central coast. At the same time, Bennett makes out a conclusive case for placing this "Middle II, Sub-period C" as pre-Late Chimu on the presence of the Black-white-red and the absence of the characteristic Chimu forms in the black ware associated with it.

The cemetery at *V-142* and the collection found there are consistent with this picture of the upper Middle Period. There is little doubt that *V-142* can be grouped with Huaca de la Cruz (Bennett, 1939, pp. 28–51), Taitacantin (Bennett, 1939, pp. 51–53; Kroeber, 1930, p. 79), and Huaca Larga (Bennett, 1939, pp. 51–53), all sites of this subperiod in the Virú Valley. A more detailed examination of the data shows *V-142* vessel forms paralleling closely those from these three sites. The large percentage of olla forms with short collars and bulged, flared, or occasionally angled rims, the presence of globular vessels with constricted necks and nubbin shoulder handles, and the rare occurrences of double-vessels or stirrup-spout vessels are particularly meaningful in this comparison. Rarity or absence of shallow bowls, the absence of tripod legs, and the presence of appliqué nodes as a common decorative element are further similarities between the Huaca Cruz-Taitacantin-Huaca Larga group and *V-142*.

The very few graves and vessels presented here from *V-142* render it impossible to make valid percentage comparisons of the styles represented between this site and Huaca de la Cruz or Taitacantin. There is, though, at *V-142* a suggestion of the proportional relationships among styles or wares that are seen in the Huaca de la Cruz and Taitacantin collections. Black and gray ware has the highest frequency of occurrence; orange or red ware is next highest; and the Black-white-red style appears in the minority percentages of 11, 28, and 7 at Huaca Cruz, Taitacantin, and *V-142*, respectively.

The two most unusual specimens in the *V-142* collection are the double-vessel plant effigy and the modeled stirrup-mouth jar. The first is perhaps less so than the latter. The long, tapered spouts, flat bridge-handle, and annular pedestal bases to the effigy bodies are typical of the Middle to Late Periods of the north coast. These forms are, however, more often found in black ware than in the Black-white-red style as in this case. This hybridization of painting style and form is a clear demonstration of the fusion and contemporaneity of the Black-white-red influence and the plastic tradition of the north expressed in Middle Period black ware. The stirrup-mouth jar is more unusual in this collection in that in form it is nearer the mode of Late Chimu than any other piece recovered from *V-142*. The stirrup part of the spout is characteristically rectangular in cross section; the upright spout is straight-sided; and the lip has the typical thinning. The base of the vessel is rectangular, and the monkey situated at juncture of stirrup arc and spout is the classic Chimu hallmark. Kroeber (1926, p. 23) and others have marked the fact that not all modeled Chimu pottery is black, and this well-finished orange specimen, in spite of its color, could be classified only as Late Chimu. Its presence in the *V-142* context can best be accounted for by assuming it to be a part of the inception of the Chimu stylistic trends that were to dominate Virú after the close of the Middle Period.

It may be, of course, that *Grave 2*, the grave in which the stirrup-spout occurred, dates slightly later than other graves at the site, particularly those which contained the Black-white-red vessels. An examination of the grave lots with this in mind shows an interesting split that might possibly indicate a temporal difference. The other vessels in *Grave 2* show close resemblances to those in *Graves 1, 3, 4, 5, 6, 7, 9, and 11.* Standing apart from all these are *Graves 8, 10, and 12. Grave 8* contained both the

Black-white-red pots and one red pressed-decorated vessel; *Graves 10 and 12* yielded the only other 2 red pressed-decorated ollas in the entire collection. There are, then, some grounds for supposing the red pressed-decorated and Black-white-red graves to be slightly earlier than the black ware graves, one of which has a near-typical Chimu stirrup-mouth jar. In the face of the data from Huaca de la Cruz and Taitacantin this slim evidence for a separation is worth only passing consideration. If at all valid its real importance may be to keynote the fact of the transition which was undoubtedly taking place. This transition of ceramic styles, the gradual disappearance of the Black-white-red and the red or oxidized wares and their replacement by the Chimu forms and black or reduced wares, characterized the Virú Valley in the Middle Period.

Consistent with this interpretation has been the surface survey study of ceramics conducted in Virú as a part of the Institute of Andean Research program by James A. Ford. Ford has found the shift from the Black-white-red or upper Middle Period into Late Period Chimu to be one of gradually changing percentage frequencies in pottery styles, not a major ceramic break.

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ZOOLOGY.—*Further notes on the amphipod genus* Corophium *from the east coast of America.*[1]

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Since the publication of my paper *The amphipod genus* Corophium *on the east coast of America* (Proc. Biol. Soc. Washington **47**: 23–32. 1934), additional records have extended the range of several of the species, a new species has been described from Florida, and the female of *C. louisianum* has been discovered. I am giving detailed figures of the species so far recorded from the east coast of America, several of which have not been figured heretofore, and also a description of the female of *C. louisianum.*

In his paper *A review of the amphipod genus* Corophium *with notes on the British species* (Journ. Marine Biol. Assoc. **21** (2): 589–630. 1937), G. I. Crawford has given extensive references to the literature under the respective species. I am, therefore, giving only brief references to the literature of those species common to both Europe and America. I am following Crawford in his convenient division of the genus *Corophium* into three sections. The species of the east coast of America fall into these divisions as follows:

SECTION A: Segments of urosome separate.

1. Antenna 2, segment 4, different in ♂ and ♀ ..... *C. rioplatense*, p. 48
2. Antenna 2, segment 4, alike in ♂ and ♀ ..... *C. volutator*, p. 51

SECTION B: Segments of urosome fused; uropods 1 and 2 inserted in notches in the lateral margins.

1. Antenna 2, segment 4, different in ♂ and ♀ ..... *C. acherusicum*, p. 53
   C. crassicorne, p. 53
   C. tuberculatum, p. 53
   C. insidiosum, p. 53
   C. ellisi, p. 59
   ♂ unknown.... *C. bonellii*, p. 59
2. Antenna 2, segment 4, alike in ♂ and ♀ ..... no species

SECTION C: Segments of urosome fused; uropods 1 and 2 attached ventrally; lateral margins of urosome without notches.

1. Antenna 2, segment 4, different in ♂ and ♀ ..... *C. acutum*, p. 59
   C. lacustre, p. 59
   C. louisianum, p. 63
2. Antenna 2, segment 4, alike in ♂ and ♀ ..... *C. simile*, p. 63

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Corophium rioplatense Giambiagi
Fig. 1, *a–j*

Corophium rioplatense Giambiagi, Anal. Mus. Nac. Hist. Nat. Buenos Aires **34**: 138, figs. 1–3. 1926.
Corophium rioplatense Shoemaker, Proc. Washington Biol. Soc. **34**: 27. 1934.
Corophium rioplatense Crawford, Journ. Marine Biol. Assoc. **21** (2): 605. 1937.

C. rioplatense was described from the Río de la Plata in 1926 and has not been recorded elsewhere. Senora Giambiagi has kindly sent me a mature male and female, cotypes of her species, from which the accompanying figures were drawn.

Male.—Head without rostrum; lateral lobes short and rounding. The eyes of the specimens examined were rather indistinct, but this is probably due to their state of preservation. Antenna 1 reaching almost to the middle of the fifth joint of antenna 2; first joint without proximal spines on inner margin, but with a number of long, forward-curving setae, lower margin with a single forward-pointing distal spine; flagellum consisting of six or seven joints. Antenna 2, fourth joint with lower margin produced distally into a curved tooth above which is a smaller tooth, fifth joint with a small blunt tooth on lower proximal margin, lower margins of fourth and fifth joints and flagellum furnished with tufts of very long setae.

Mandibular palp, first joint not produced distally, but apically rounding with the plumose seta attached somewhat submarginally; second joint longer than the first and bearing the usual plumose seta beside which is a shorter seta. Gnathopod 1, palm evenly convex, without defining angle, armed on inside surface with four or five slender spines and with several longer spines where the palm passes into the lower margin of the joint, entire palm very finely denticulate; seventh joint with inner margin bearing a distal tooth behind which are very fine denticulations. Gnathopod 2, seventh joint bearing two teeth on inner margin.

Uropod 1, peduncle with three stout spines on outer lateral margin followed proximally by a slender spine, and there appears to be a small spine at the distal angle, inner margin with a small distal spine; the lower distal margin of peduncle produced into a long triangular process with rounding apex; outer ramus with four spines on outer margin, and the usual group of distal spines, inner margin without spines; inner ramus bearing the same spination as outer ramus. Uropod 2, peduncle without spines; rami with distal spines and each ramus with a single spine on outer lateral margin, but none on inner margins. Uropod 3, ramus longer than peduncle. Telson wider than long. Length of the male examined about 3 mm from front of head to end of uropods.

Female.—The female differs from the male principally in antenna 2. Antenna 1 reaching to the distal end of the fifth joint of antenna 2; first joint armed with one spine at the proximal end of the inner margin (Giambiagi's figure shows two spines), lower margin bearing a single distal spine as in male; flagellum consisting of about seven joints. Antenna 2, short and stout; fourth joint with lower margin produced distally into a thin angular lobe bearing a distal spine above which are three smaller spines; five spines borne on low protuberances on inner surface of lower margin; and two spines on inner surface, one near the distal edge of joint and the other about the middle; fifth joint with a low triangular protuberance bearing a spine situated near the middle of the lower margin, and a smaller protuberance near the proximal end of lower margin. Head without rostrum; lateral lobes short and rounding. Mandibular palp as in male, but with a single plumose seta at the apex of the second joint Gnathopod 1 as in male, but bearing about seven submarginal spines on inside edge of palm. Gnathopod 2 like that of male. The uropods of the female are partially missing, and the third uropods lack the rami. The first uropod on the right side is present and appears to be uninjured. The peduncle of this uropod bears no spines, but has three long, slender setae on the outer lateral margin, and the lobe or projection at the lower distal end is sharply triangular; the spine-arrangement of the rami is about the same as in the male. In Giambiagi's figure (3, Ur. 3 ♀) of uropod 3 of the female the ramus is equal in length to the peduncle.

The fifth peraeopods are lacking on both the male and female at my disposal, but, according to Giambiagi's drawing (fig. 3, p. 7), the second joint of this peraeopod, at least in the male, is very narrow and not at all expanded. The female measures about 4 mm from the front of the head to the end of the uropods.

The female here figured has fully developed marsupial plates and appears to be fully mature, but the male is smaller and may not have reached its maximum size.

Corophium species

Dr. Leonard P. Schultz, in 1942, collected a number of specimens of *Corophium* in brackish water in Ciénaga del Guanavana (swamp), 10

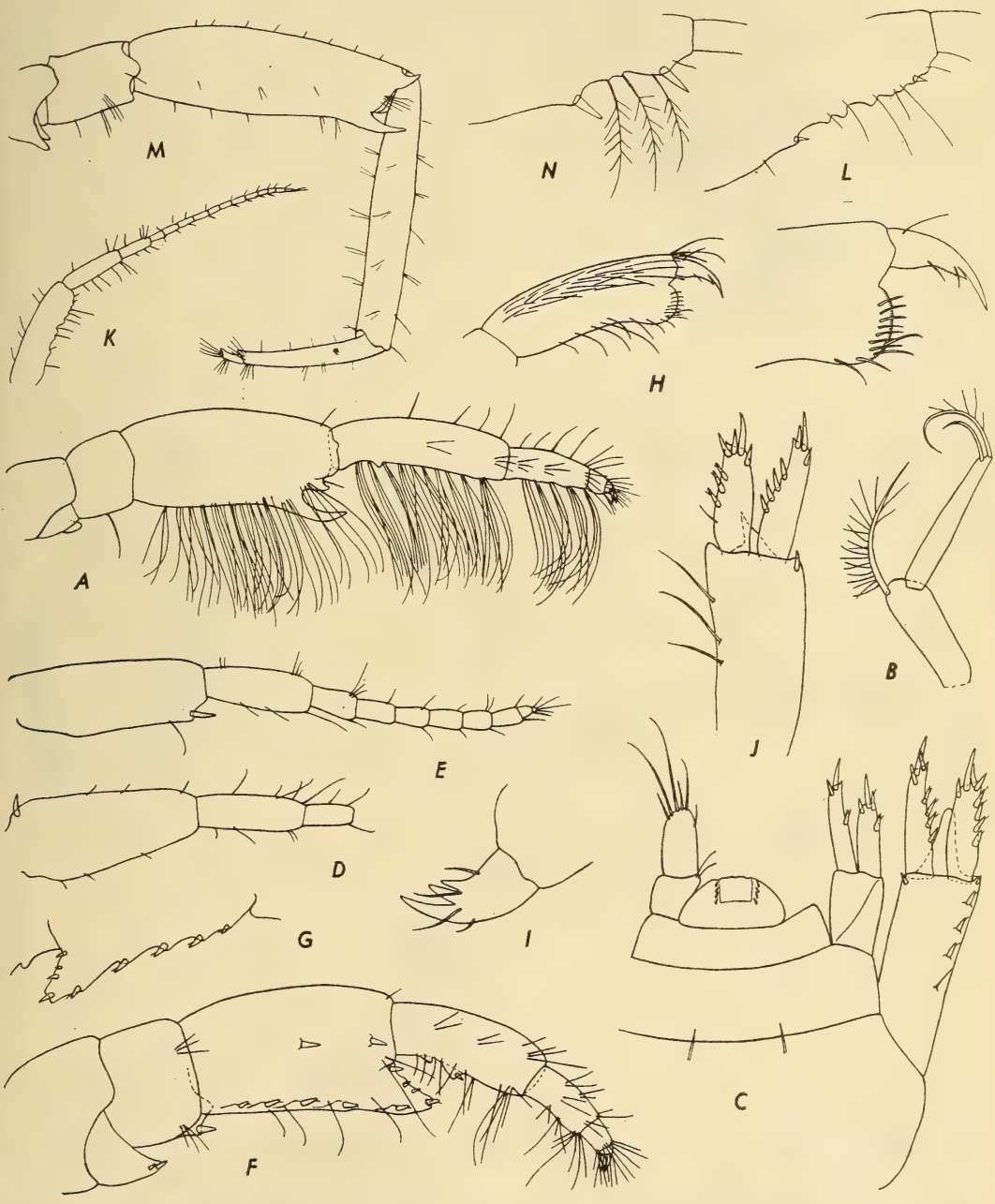


FIG. 1.—*Corophium rioplatense* Giambiagi, male: *a*, antenna 2; *b*, mandibular palp; *c*, urosome and appendages; female: *d*, antenna 1, top view; *e*, antenna 1, side view; *f*, left antenna 2, inside view; *g*, lower margin of fourth joint of antenna 2, tilted to show protuberances and spines; *h*, gnathopod 1; *i*, end of gnathopod 2; *j*, right uropod 1. *Corophium volutator* Pallas, male: *k*, antenna 1; *l*, antenna 1, lower margin or first joint; *m*, left antenna 2, inside view; female: *n*, antenna 1, lower margin of first joint.

km north of Sinnamaica, Venezuela. These specimens were dried out, but after soaking in warm water they show many characters possessed by *C. rioplatense*. Without fresh material from Ciénaga del Guanavana, and a series of *C. rioplatense* showing growth characters, I do not feel justified in identifying this Venezuelan material as *C. rioplatense*.



FIG. 2.—*Corophium acherusicum* Costa, male: *a*, anterior part of animal; *b*, head from above; *c*, mandibular palp; *d*, maxilliped; *e*, gnathopod 1; *f*, seventh joint of gnathopod 2; *g* peraeopod 5; *h*, urosome and appendages.

The characters of the male agree with those of the male of *C. rioplatense;* it is without rostrum and uropod 1 possesses the long spatulate distal lobe. In the female young specimens bear four spines beside the distal spine on the lower margin of the fourth joint of antenna 2; in older females there are three spines in addition to the distal spine on the lower margin and two spines on the inner surface of the fourth joint, as shown for *C. rioplatense* (fig. 1, *f*). On the upper margin of the distal lobe of this fourth joint are one or more small spines; the fifth joint has a protuberance armed with a spine in the middle of the lower margin as in *C. rioplatense.* The inner margin of the first joint of antenna 1 bears three proximal spines and the lower margin bears four or five spines. Giambiagi does not mention the number of spines on the lower margin of this joint, but in the female that I have studied there is only a distal spine, as I have shown in Fig. 1, *e.* Gnathopods 1 and 2 are like those of *C. rioplatense.* Uropod 1 of the female has the sharply triangular lobe as in *C. rioplatense.* Length of female from front of head to end of uropods 3.5 to 4 mm. The male is smaller.

Corophium volutator (Pallas)

Fig. 1, *k–n*

Oniscus volutator Pallas, Miscellanea Zoologica: 192, pl. 14, fig. 20. 1766.
Corophium grossipes Sars, Crust. Norway **1**: 614, pl. 219. 1894.
Corophium volutator Blake, *in* Procter, Biol. Survey Mount Desert Region, pt. 5: 255. 1933.
Corophium volutator Shoemaker, Proc. Biol. Soc. Washington **47**: 23. 1934.
Corophium volutator Crawford, Journ. Marine Biol. Assoc. **21** (2): 595. 1937.

C. volutator is much more widely distributed in Europe than it is in America, where it has been recorded only from the Bay of Fundy and the coast of Maine. It is a large species, about 6 mm in length and is the type species of the genus. I have figured the antennae of the male and the first joint of the first antenna of the female. The second antenna of the female, though smaller, resembles that of the male, having the curved tooth at the lower distal corner of the fourth joint, but not the inward-curving tooth at the upper distal corner. Crawford (1937, p. 596) says of *C. volutator,* " . . . forming tubes intertidally in the mud of estuarine mud-flats, salt-marsh pools, and brackish

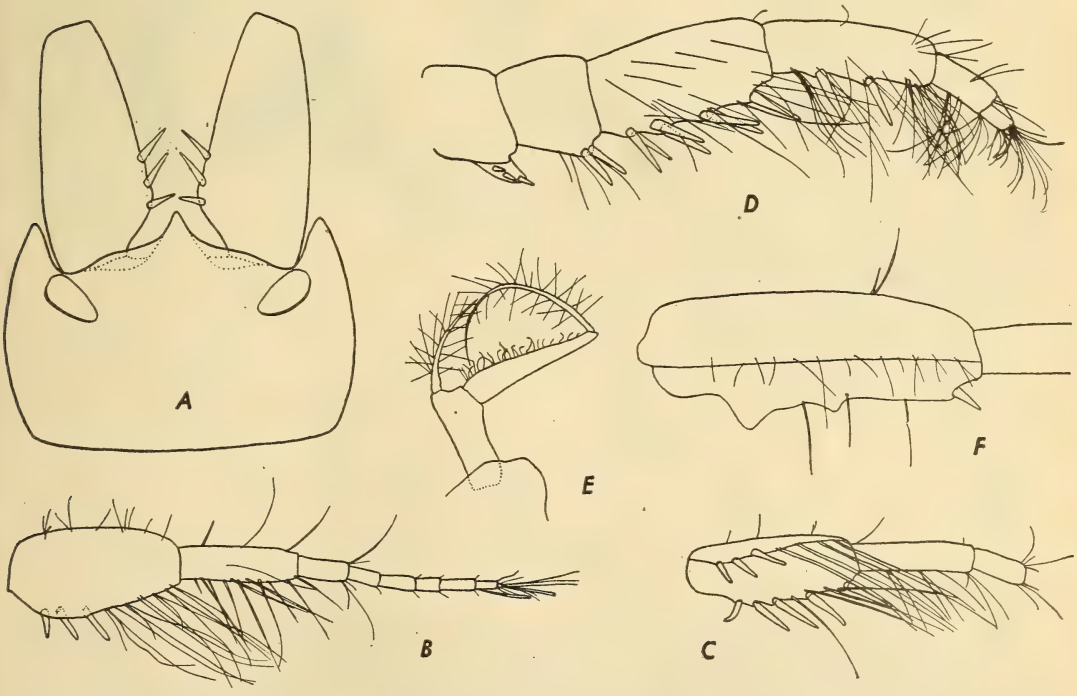


FIG. 3.—*Corophium acherusicum* Costa, female: *a,* head and first antennae from above; *b,* left antenna 1 from above; *c,* left antenna 1 showing spines on lower margin; *d,* left antenna 2; *e,* mandibular palp; male: *f,* left antenna 1 showing spine and protuberances on lower margin.



FIG. 4.—*Corophium crassicorne* Bruzelius, male: *a*, right antenna 1, top view; *b*, antenna 1, side view; *c*, antenna 2, side view; *d*, antenna 2 showing small spines on inner surface of lower margin; *e–h*, antenna 2 showing successively younger stages; *i*, gland cone of antenna 2; *j*, mandible; *k*, gnathopod 2; *l*, top of head showing rostrum and lateral lobes; *m*, peraeopod 5; *n*, urosome and appendages; female: *o*, right antenna 1, top view; *p*, antenna 1, side view; *q*, antenna 2, side view; *r*, gland cone, inside view; *s*, gnathopod 1; *t*, gnathopod 2.

ditches. In some of the streams running into the Tamar it lives in almost fresh water associated with a number of insect larvae. In many of its localities, however, the water is nearly of full salinity." The specimens here figured were taken in the Shubenacadie River at Urbania, Nova Scotia, by the Biological Board of Canada.

Corophium acherusicum Costa

Figs. 2, 3

Corophium acherusicum Costa, Mem. Accad. Sci. Napoli **1**: 232. 1857.
Corophium acherusicum Shoemaker, Proc. Biol. Soc. Washington **47**: 24. 1934.
Corophium acherusicum Crawford, Journ. Marine Biol. Assoc. **21** (2): 617, fig. 2, P. 1937.

Specimens in the national collection which were formerly identified as *Corophium cylindricum* Say have proved to be the same species as *C. acherusicum* Costa, which has a wide distribution both in the Eastern and Western Hemispheres.

Crawford gives as the distribution: Southern England; coasts of France and Holland; Mediterranean; northern coast of Africa from the Suez Canal to Senegal; Durban Bay; Dar-es-Salaam; and Lyttleton Harbor, New Zealand. In the National Museum there are specimens from the east coast of America from Baffin's Bay to Brazil; and from the west coast from Alaska, Vancouver Island, and California (Monterey Bay, San Francisco Bay, and Newport Bay); also from Oahu, Hawaiian Islands, and from a ship's bottom at Hong Kong.

Corophium crassicorne Bruzelius

Fig. 4

Corophium crassicorne Bruzelius, Kongl. Svenska Vet.-Akad. Handl. Stockholm (n. ser.) **3** (1): 15, pl. 1, fig. 2. 1859.
Corophium crassicorne Sars, Crust. Norway **1**: 615, pl. 220. 1894.
Corophium crassicorne Stebbing, Das Tierreich, Amphipoda. I Gammaridea: 690, figs. 116–118. 1906.
Corophium crassicorne Blake, *in* Procter, Survey Mount Desert Region, pt. 5: 255. 1933.
Corophium crassicorne Shoemaker, Proc. Biol. Soc. Washington **47**: 24. 1934.
Corophium crassicorne Crawford, Journ. Marine Biol. Assoc. **21** (2): 607, figs. 4 a–f. 1937.

Dr. K. Stephensen (*The Tanaidacea and Amphipoda of the Arctic*, Fauna Arctica, 1932, p. 372) gives as the distribution of this species, "From southern Spitzbergen and Barents Sea to Black Sea; Jan Mayen (not Greenland and Iceland)." In 1933 Blake recorded it from Mount Desert Island, Maine. In 1934 I extended the range on the east coast of North America from Bay of Fundy to Gardiners Bay, Long Island, New York. Two fully developed females collected by Dr. Wm. H. Dall at Chichagof Harbor, Attu, Alaska, June 20, 1873, are undoubtedly this species. I can find no published records of the extension of the range of *C. crassicorne* since 1934. A. O. Walker in 1904 recorded the species from Ceylon. Dr. Chas. Chilton in 1921 recorded it from Chilka Lake and New Zealand, and said that he also had specimens from Port Jackson, New South Wales. In 1925 Dr. Chilton recorded it from Talé Sap, India. It is now thought that these specimens recorded by Walker and Chilton should be referred to *C. triaenonyx* described by T. R. R. Stebbing in 1904 from Ceylon (Spolia Zeylanica **2**, pt. 5; 25, pl. 6a), as this species has several characters resembling those of *C. crassicorne*.

Corophium tuberculatum Shoemaker

Fig. 5

Corophium tuberculatum Shoemaker, Proc. Biol. Soc. Washington, **47**: 29. 1934.
Corophium tuberculatum Crawford, Journ. Marine Biol. Assoc. **21** (2): 623. 1937.

Since the description of this species in 1934, very fine additional specimens have been received at the National Museum, which extend the range considerably southward. *Corophium tuberculatum* is at present represented by specimens from Woods Hole, Mass.; Amityville, Long Island, N. Y.; Mispitton Cove, Delaware Bay, Del.; many specimens from Chesapeake Bay, taken by the steamer *Fish Hawk;* off Bogue Inlet, N. C. (*Fish Hawk* station 8286); Edisto Island, S. C. (taken by T. K. *Ellis*); Fernandina, Fla. (taken by Andrew Pizzini); Sarasota Bay, Fla. (taken by M. W. Williams); and Deer Island, off Biloxi, Miss. (taken by M. W. Williams).

This species appears to prefer the waters of bays and estuaries, and it has not been recorded outside the east coast of the United States.

Corophium insidiosum Crawford

Figs. 6, 7

Corophium insidiosum Crawford, Journ. Marine Biol. Assoc. **21** (2): 615. fig. 2 a–g. 1937.

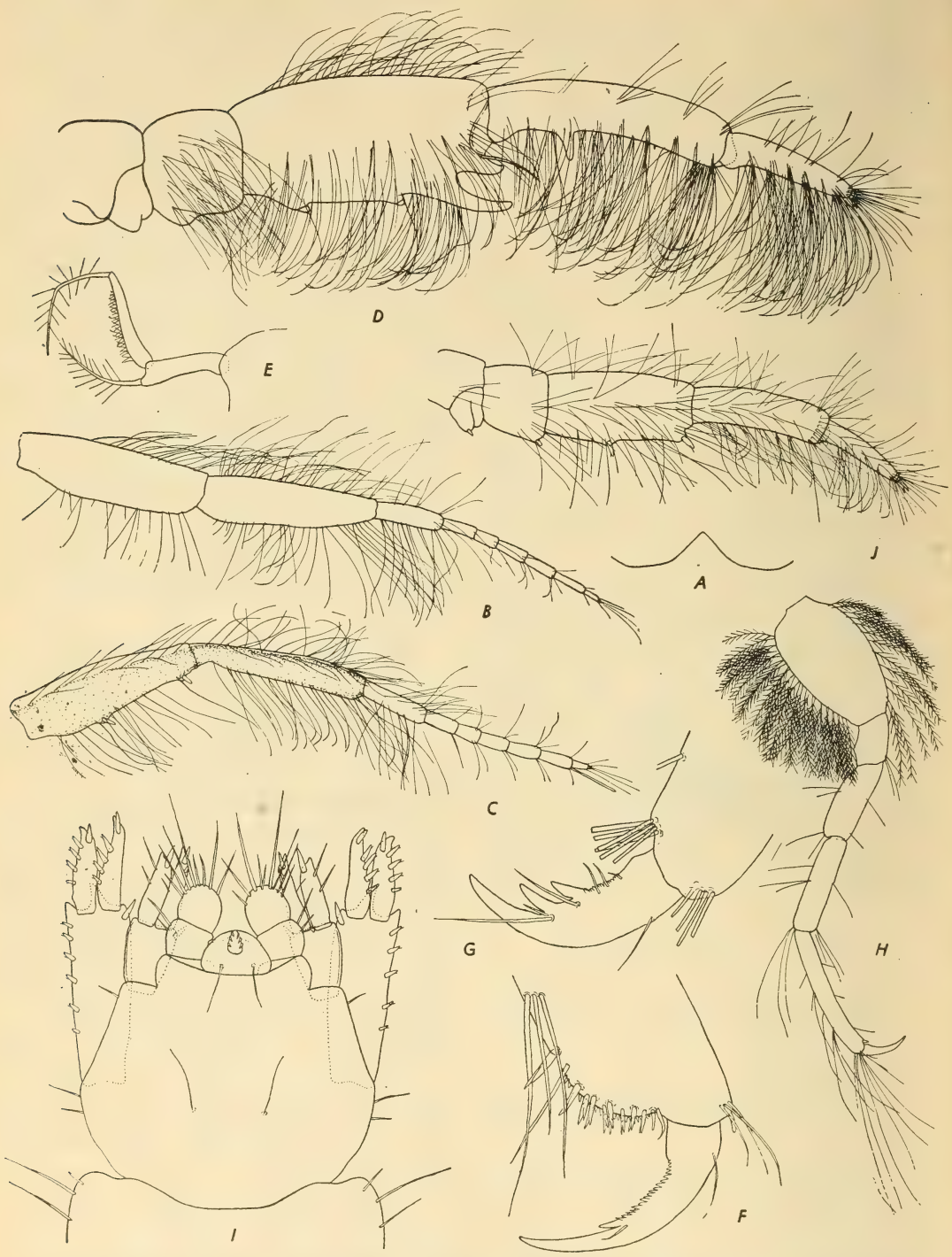


FIG. 5.—*Corophium tuberculatum* Shoemaker, male: *a*, rostrum, like that of female; *b*, antenna 1 from above; *c*, antenna 1, side view; *d*, antenna 2; *e*, mandibular palp; *f*, gnathopod 1; *g*, gnathopod 2; *h*, peraeopod 5; *i*, urosome and appendages; female: *j*, antenna 2.

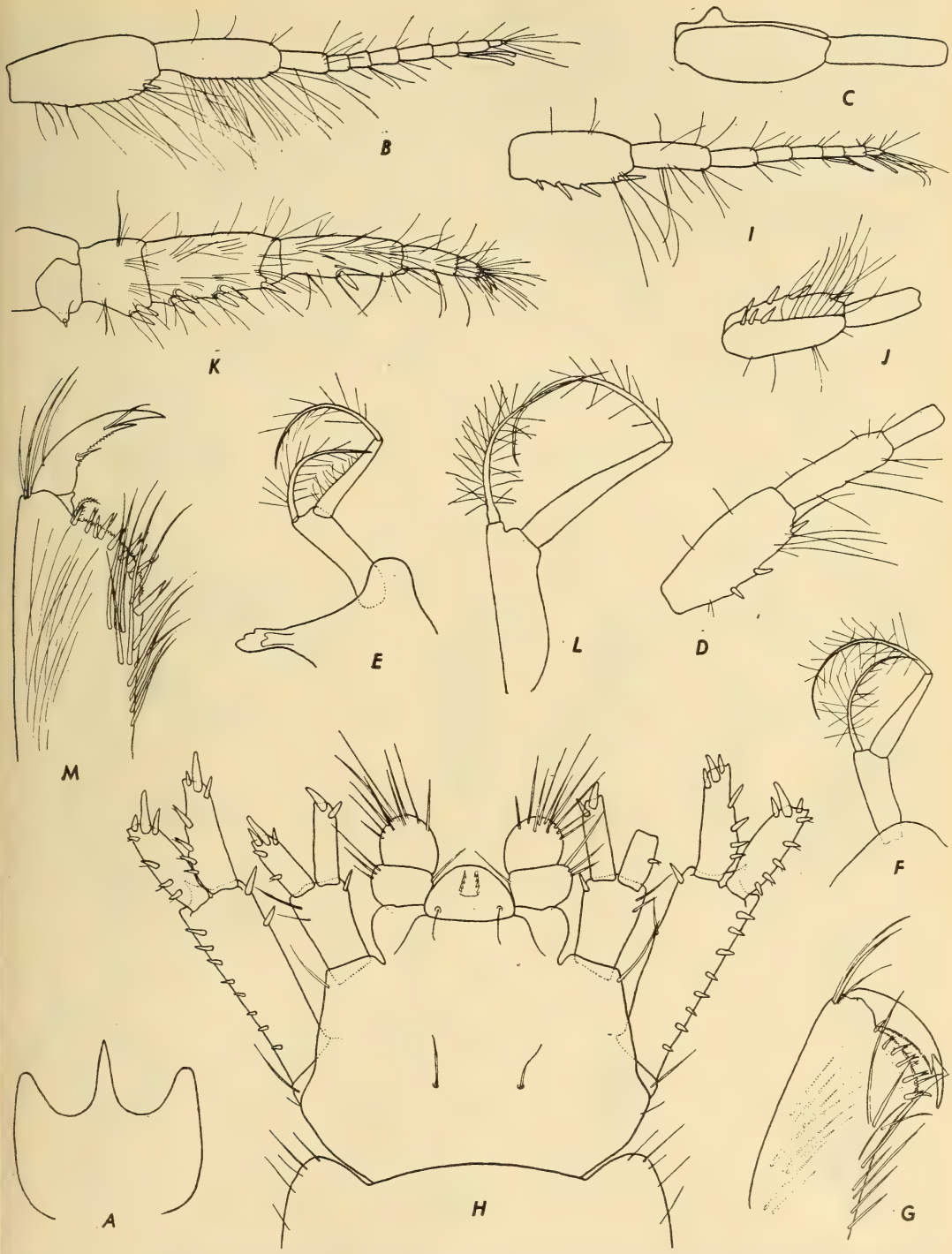


FIG. 6.—*Corophium insidiosum* Crawford, male: *a*, head showing rostrum and lateral lobes; *b*, antenna 1, side view; *c*, right antenna 1 from above, showing inner lobe; *d*, antenna 1 of young male, side view showing spines on lower margin; *e*, mandible; *f*, mandibular palp of a male from Chile; *g*, gnathopod 1; *h*, urosome and appendages; female: *i*, antenna 1, side view; *j*, antenna 1, top view showing the proximal spine of inner margin and the spines of lower margin; *k*, antenna 2; *l*, mandibular palp; *m*, gnathopod 1.

In reexamining the material in the National Museum, I have found this species to be present on both the east and west coasts of America. Crawford has already recorded it from Oakland, Calif. In the national collection there are specimens from Newburyport, Mass.; Amityville, Long Island, N. Y.; Oakland Estuary and Point Richmond, San Francisco Bay, Calif.; Oyster Bay, Totten Inlet, Puget Sound, Wash.; and from an islet off the pier at Talcahuana, Chile. Crawford gives the distribution as follows: England; Denmark; Kieler Bucht, Germany; Lake of Venice, Italy; and Oakland, San Francisco Bay, California.

The female of this species closely resembles that of *C. bonellii*, but males of *C. insidiosum* are fairly common, whereas the male of *C. bonellii* is unknown.

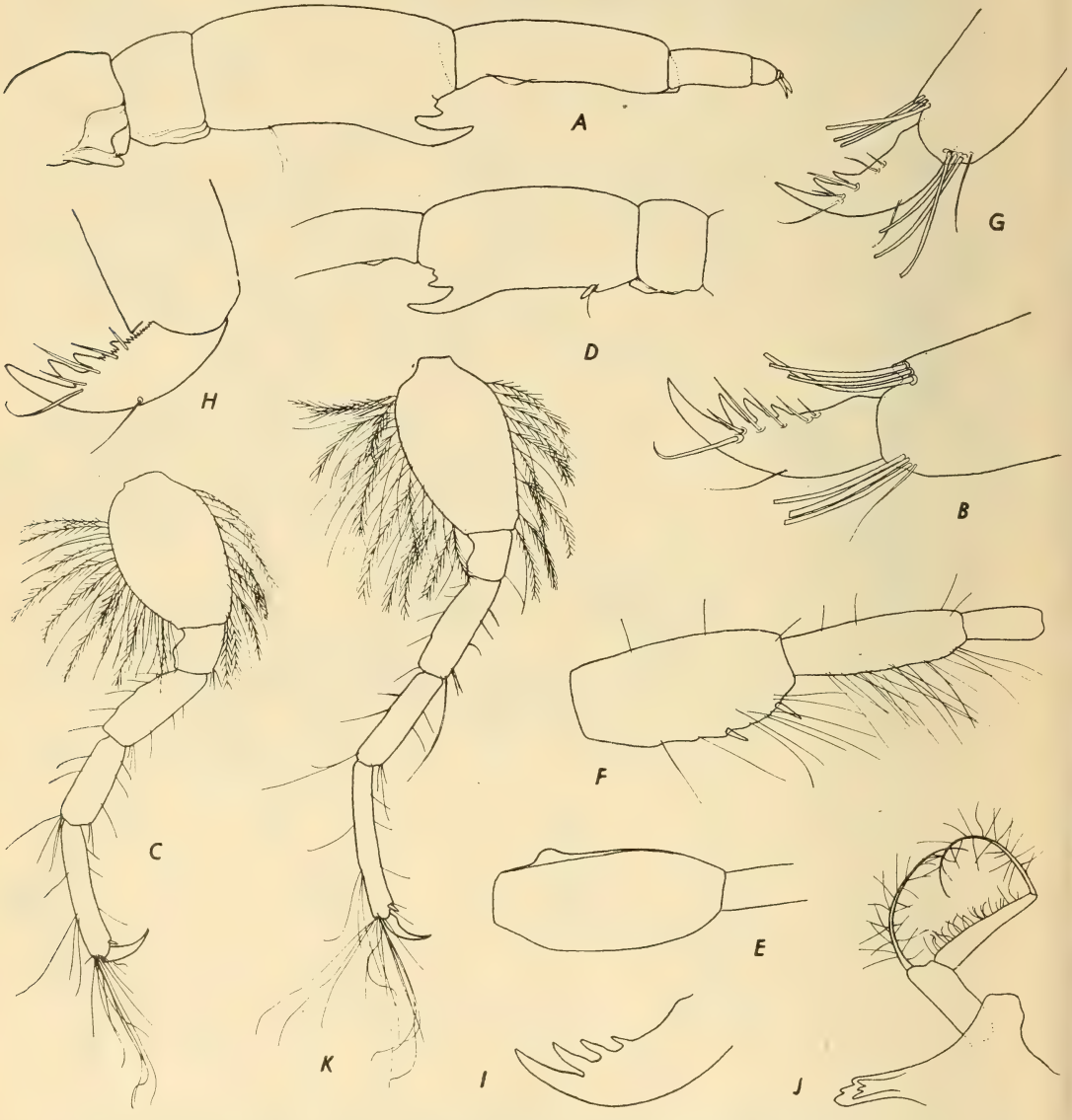


Fig. 7.—*Corophium insidiosum* Crawford, male: *a*, antenna 2 of mature male; *b*, gnathopod 2; *c*, peraeopod 5; *d*, antenna 2 of young male showing a proximal spine on lower margin of fourth joint; *e*, *f*, top and side views of antenna 1 of young male; *g*, gnathopod 2 of a young male; female: *h*, gnathopod 2; *i*, seventh joint of gnathopod 2 of a female from Chile; *j*, mandible of a female from Chile; *k*, peraeopod 5.

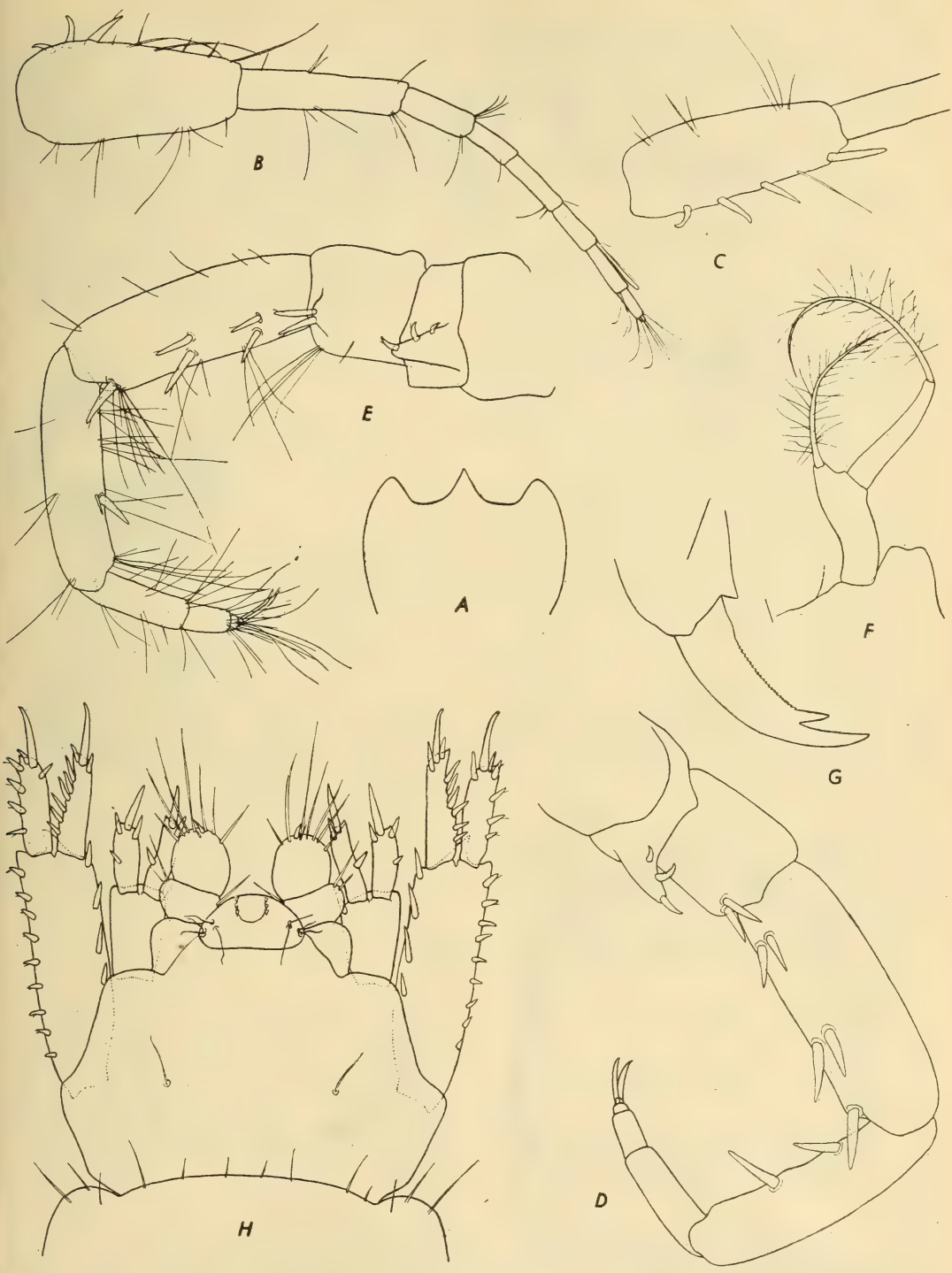


FIG. 8.—*Corophium bonellii* Sars, female: *a*, top of head showing rostrum and lateral lobes; *b*, right antenna 1, top view; *c*, antenna 1, side view showing spines on lower border; *d*, antenna 2; *e*, antenna 2 with only one spine on fifth joint; *f*, mandibular palp; *g*, gnathopod 2; *h*, urosome and appendages.

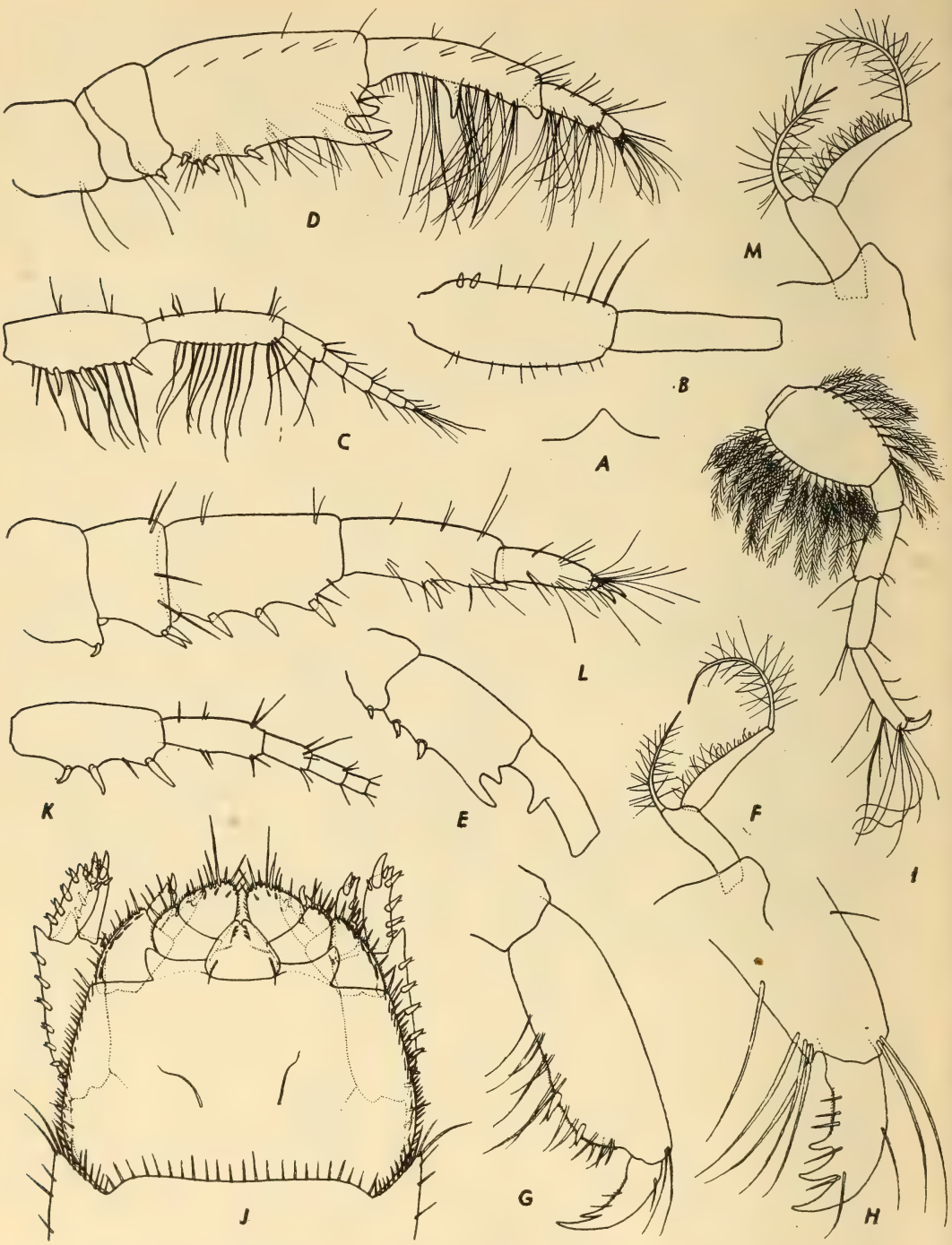


FIG. 9.—*Corophium acutum* Chevreux, male: *a*, rostrum, like that of female; *b*, right antenna 1 from above; *c*, antenna 1, side view; *d*, antenna 2; *e*, antenna 2 of young male; *f*, mandibular palp; *g*, gnathopod 1; *h*, gnathopod 2; *i*, peraeopod 5; *j*, urosome and appendages; female: *k*, antenna 1, side view (the inner margin of first joint bears two proximal spines as in male); *l*, antenna 2; *m*, mandibular palp.

Corophium ellisi Shoemaker

Corophium ellisi Shoemaker, Charleston Mus. Leaflet No. 18: 3, fig. 1. 1943.

The first and up to the present time the only known specimens of this species were collected by T. K. Ellis from the stomach of a ray taken in Lemon Bay, Sarasota County, Fla. Recently M. W. Williams collected for the National Museum very fine mature specimens of both sexes of *C. ellisi* at Sarasota Bay, Fla., which record extends the range a few miles southward along the west coast of Florida.

Corophium bonellii (Milne-Edwards) G. O. Sars

Fig. 8

Corophia bonellii H. Milne-Edwards, Ann. Sci. Nat. **20**: 385. 1830.

Corophium bonellii H. Milne-Edwards, Hist. Nat. Crust. **3**: 67. 1840.

Corophium bonelli Sars, Crust. Norway **1**: 616, pl. 221, fig. 1. 1894.

Corophium pseudacherusicum Schellenberg, Further zool. results, Swedish Antarctic Exped. 1901–1903, **2** (6): 258, fig. 134. 1931.

Corophium pseudacherusicum Shoemaker, Proc. Biol. Soc. Washington **47**: 25. 1934.

Corophium bonelli Crawford, Journ. Marine Biol. Assoc. **21** (2): 608, fig. 2 h–o. 1937.

The description and figures of the female specimens by G. O. Sars in 1894 have been accepted by Crawford as fixing the status of *C. bonellii*. He has examined some of the specimens used by Sars and has redescribed them and figured the diagnostic appendages. He has shown that *C. pseudacherusicum* Schellenberg is a synonym of *C. bonellii*, and has also called attention to the confusion which has existed among *C. bonellii*, *C. acherusicum*, and his new species *C. insidiosum*.

As there has never been a male among the many thousands of specimens of *C. bonellii* that have been taken, Crawford thinks it probable that the species is parthenogenetic. Parthenogenesis is of rare occurrence in the Amphipoda.

I have reexamined the material in the National Museum in the light of Crawford's diagnoses and find that both *C. bonellii* and *C. insidiosum* are well represented. *C. bonellii* appears to be rather common on the coasts of Nova Scotia and New England. Proceeding southward, there are no further records in the Museum until the Falkland Islands are reached. There are also specimens from Punta Arenas, Chile. Crawford gives as the distribution Northern Europe; British Isles; France; Denmark; Italy; east coast of North America; Brazil (500 miles ENE. of Rio de Janeiro); Falkland Islands; and Punta Arenas, Chile.

Corophium acutum Chevreux

Fig. 9

Corophium acutum Chevreux, Bull. Soc. Zool. France **33**: 75, fig. 6. 1908.

Corophium acutum Chevreux, Mem. Soc. Zool. France **23**: 271. 1911.

Corophium acutum Chevreux and Fage, Faune de France, 9 Amphipodes: 366, figs. 359, 374. 1925.

Corophium acutum Schellenberg, Trans. Zool. Soc. London **22**, pt. 5: 672. 1928.

Corophium acutum Shoemaker, Proc. Biol. Soc. Washington **47**: 26. 1934.

Corophium acutum Schellenberg, Fisheries Research Directorate (Egypt). Notes and Memoirs No. 18 (The Fisheries Grounds near Alexandria. 10.—Amphipoda Benthonica): 22. 1936.

Corophium acutum Crawford Journ. Marine Biol. Assoc., **21** (2): 624. 1937.

Corophium acutum Ruffo, Ann. Mus. Civ. Storia Nat. Genova **60**: 147. 1938.

Corophium acutum Salfi, Arch. Zool. Torino **27**: 31, figs. 4–7. 1938.

Corophium acutum Ruffo, Boll. Inst. Ent. Univ. Bologna **11**: 123. 1941.

There have been no additional records of *C. acutum* from America since the publication of my paper in 1934. It has been recorded from Woods Hole, Mass.; Lond Island Sound; Cape May, N. J.; and from the vicinity of Rio de Janeiro, Brazil. *C. acutum* appears to occur very sparingly in America, but it has a very wide distribution elsewhere, as it has been recorded from the following localities: Southern England; France; Monaco; Suez Canal; Algeria; Durban, Natal; Auckland; and New Zealand.

Corophium lacustre Vanhöffen

Fig. 10

Corophium lacustre Vanhöffen, Sitzungsb. Ges. Naturf. Berlin 1911, no. 9: 400, figs. 1–4. 1911.

Corophium lacustre Sexton, Proc. Zool. Soc. London 1912: 664, pl. 74, figs. 13–17. 1912.

Corophium lacustre Shoemaker, Proc. Biol. Soc. Washington **47**: 27. 1934.

Corophium lacustre Crawford, Journ. Marine Biol. Assoc. **21** (2): 625. 1937.

Since my paper of 1934 the range of *C. lacustre* has been extended both northward and southward along the east coast of the United States. In 1934 the range extended from Chesa-



FIG. 10.—*Corophium lacustre* Vanhöffen, male: *a*, rostrum; *b*, right antenna 1 from above; *c*, antenna 1, side view; *d*, lower margin of first joint of antenna 1; *e*, antenna 2; *f*, mandibular palp; *g*, *h*, gnathopod 1; *i*, gnathopod 2; *j*, peraeopod 5; *k*, urosome and appendages; female: *l*, rostrum; *m*, right antenna 1 from above; *n*, antenna 1, side view; *o*, *p*, antenna 2.

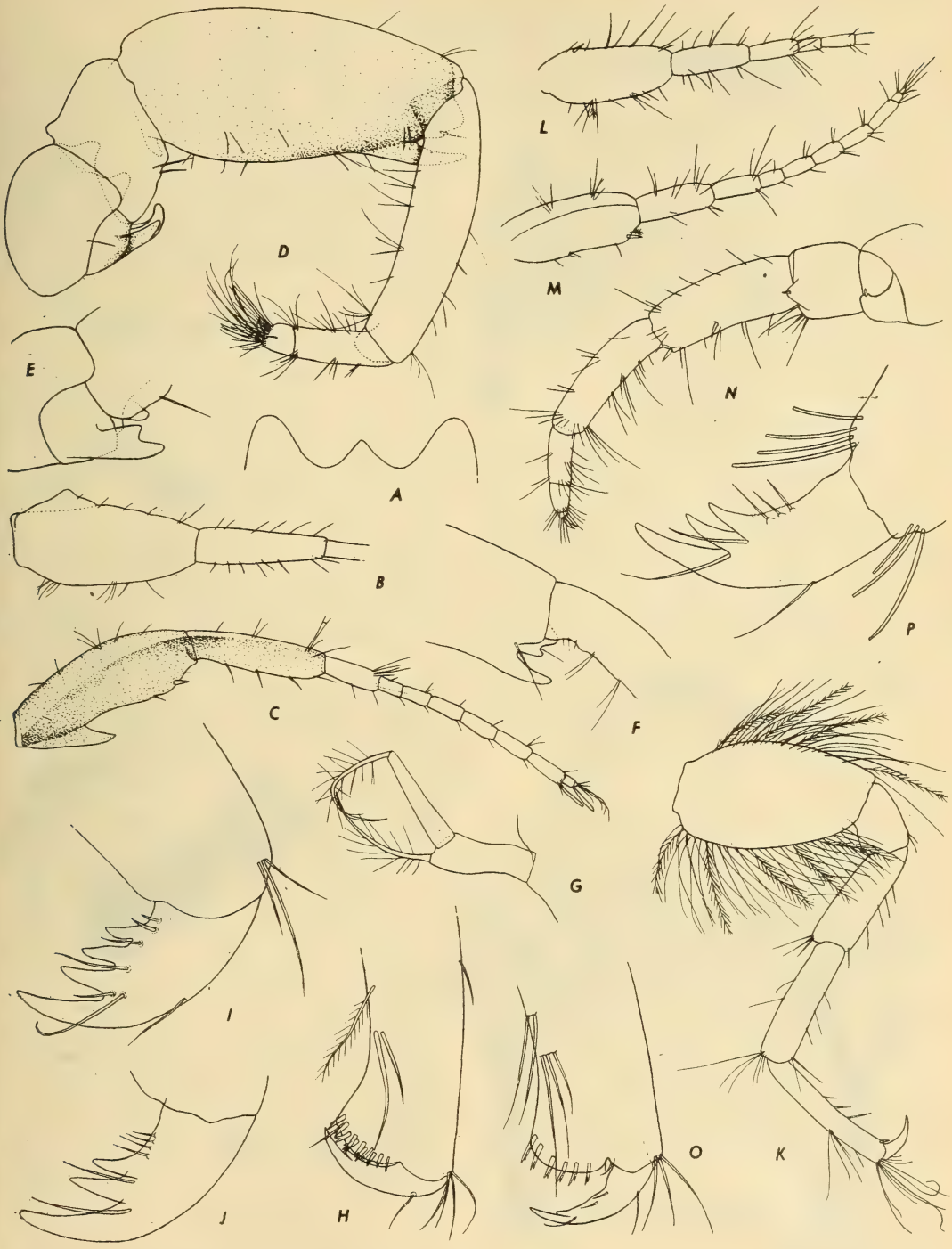


FIG. 11.—*Corophium louisianum* Shoemaker, male: *a*, rostrum and eye lobes; *b*, right antenna 1 from above; *c*, antenna 1, side view; *d*, antenna 2; *e*, second joint of antenna 2 showing gland-cone; *f*, fourth joint of antenna 2 showing small accessory distal tooth; *g*, mandibular palp; *h*, gnathopod 1; *i*, seventh joint of gnathopod 2 of type showing the three teeth on inner margin; *j*, seventh joint of gnathopod 2 showing two teeth on inner margin; *k*, peraeopod 5; female: *l*, right antenna 1 from above; *m*, right antenna 1, side view; *n*, antenna 2 showing spines on inner surface of fourth joint; *o*, gnathopod 1; *p*, seventh joint of gnathopod 2.

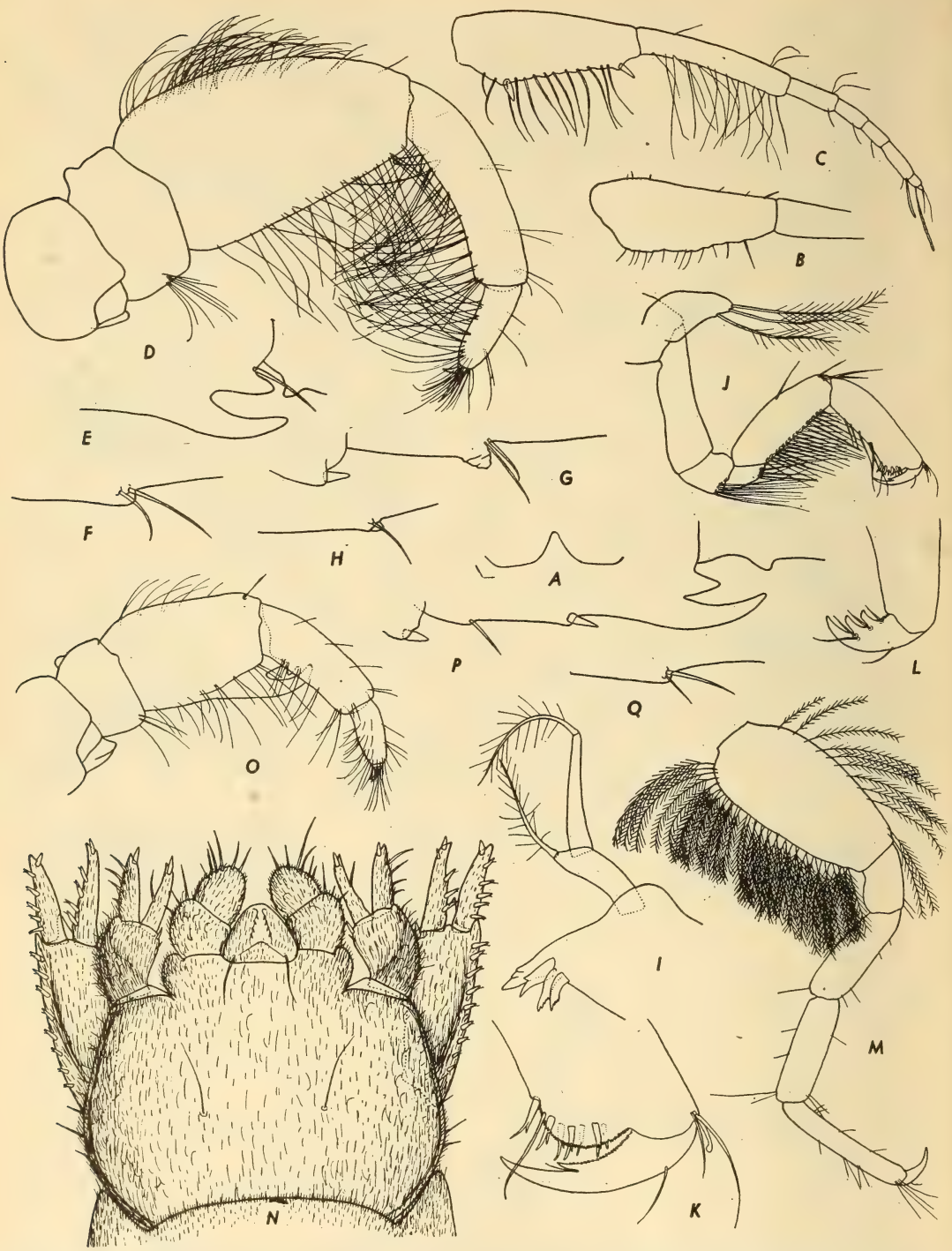


FIG. 12.—*Corophium simile* Shoemaker, male: *a*, rostrum; *b*, right antenna 1 from above; *c*, antenna 1, side view; *d*, antenna 2; *e*, antenna 2, specimen from May River, S. C.; *f*, *g*, *h*, tubercle on lower margin of fourth joint of antenna 2 of three different specimens; *i*, mandible; *j*, *k*, gnathopod 1; *l*, gnathopod 2; *m*, peraeopod 5; *n*, urosome and appendages; female: *o*, antenna 2; *p*, antenna 2 showing spine on lower margin of fourth joint of female from Vineyard Sound, Mass.; *q*, proximal tubercle on lower margin of fourth joint of a specimen from New Haven Harbor, Conn.

peake Bay to Winyah Bay, S. C. The National Museum has since received specimens from Haverstraw on the Hudson River, N. Y. (taken by H. K. Townes); Fort Raleigh, Roanoke Island, N. C.; Cooper River and Alligator Creek, S. C.; and Welaka, Fla. (taken by the U. S. Bureau of Fisheries). In Europe this species has been recorded from the coasts of Germany, Finland, Holland, France, and England.

C. lacustre extends up the rivers of the east coast of the United States into waters that are very nearly fresh.

Corophium louisianum Shoemaker

Fig. 11

Corophium louisianum Shoemaker, Proc. Biol. Soc. Washington **47**: 30. 1934.

Corophium louisianum Crawford, Journ. Marine Biol. Assoc. **21** (2): 626. 1937.

When this species was described in 1934 there were only two known specimens, both males, one from Chef Menteur, La., and one from Biloxi, Miss. During the summer of 1944 M. W. Williams obtained for the National Museum mature specimens of both sexes at Biloxi, Miss., and at Sarasota Bay, Fla. *C. louisianum* is a tube-building species.

In describing the second antenna of the male (1934, p. 30), I said, "Fourth joint large and powerful, lower distal corner produced into a strong, slightly curved tooth, above which on the inside of the joint is a prominent distal lobe bearing a notch and setule." While this description is correct for the type specimen, most of the fully developed males possess a small tooth below this notch, as shown by Fig. 11, *f*. I also stated in the original description that pleon segments 4–6 were coalesced with their united lateral margins raised into a ridge above the dorsal surface. I should have said that the united lateral margins of the fourth and fifth segments are raised into a ridge above the dorsal surface. This ridge is very prominent in both sexes and does not show any interruption between the fourth and fifth segments. This correction also applies to pleon segments 4–6 of *Corophium simile*, which I described in the same paper.

The inner margin of the seventh joint of gnathopod 2 of the male bears two teeth, but occasionally there are three.

The female resembles the male except in the antennae. In the female the first joint of antenna 1 does not possess the protuberance on the upper inner margin or the forward-pointing tooth on the lower margin, but has only one proximal spine on inner margin and two small forward-pointing spines on the lower margin. In antenna 2 the second joint is produced below into a curved lobe bearing a small spine; the third joint bears a short anterior lobe armed with a short spine; the fourth joint bears on the lower margin a distal spine and another spine a little forward of the center; the fifth joint is without spines. The palm of gnathopod 1 is convex and passes by an evenly rounding curve into the hind margin of the joint, and it is armed on the outside and inside by a row of notched spines; the seventh joint bears distally on the inner margin a single forward-pointing tooth. In gnathopod 2 the seventh joint is armed on the inner margin with 2 teeth. Female measures from apex of rostrum to end of uropods from 4 to 4.5 mm.

Corophium simile Shoemaker

Fig. 12

Corophium simile Shoemaker, Proc. Biol. Soc. Washington **47**: 28. 1934.

Corophium simile Crawford, Journ. Marine Biol. Assoc. **21** (2): 626. 1937.

In 1934 the range of *C. simile* was given as extending from Vineyard Sound, Mass., to South Carolina. Since then specimens have been taken at Lemon Bay, Fla., by Olga Hartman; at Sarasota Bay, Fla., by M. W. Williams; and at Apalachicola Bay, Fla., by A. S. Pearse. Though this species has a rather wide distribution, it appears to occur in very sparing numbers. It has not been recorded except from the east coast of the United States.

ENTOMOLOGY.—*The orchid bugs of the genus* Tenthecoris *Scott (Hemiptera: Miridae).*[1] Tsai-yu Hsiao, Nankai University, Tientsin, China, and Reece I. Sailer, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by Paul W. Oman.)

For many years plant quarantine inspectors at the various United States ports have been intercepting large numbers of plant bugs of the family Miridae on Orchidaceae imported from Neotropical areas. Because of the absence of any comprehensive work treating the group of species involved, the identification of this intercepted material has been extremely inaccurate. This paper has been written in an effort to improve this situation and to provide names for several species not before described.

The genus *Tenthecoris* was established in 1886 by Scott (*8*, pp. 64–66). Previously, in 1860, Stål (*9*, pp. 57–58) had established the genus *Eccritotarsus* and included 15 species from Rio de Janeiro. This was found by Reuter and Bergroth to be a composite genus, and subsequently all the species, with the exception of *E. semiluteus*, were transferred to other genera.[2] Meanwhile, the existence of *Eccritotarsus* undoubtedly delayed recognition of Scott's genus *Tenthecoris*.

The genus *Tenthecoris* contains colorful bugs of medium size. *T. bicolor* Scott, as the only originally included species, is the genotype. *Tenthecoris* may be separated from *Eccritotarsus* and other related genera by the following combination of characters: Pronotal collar incomplete; rostrum long, attaining or surpassing apex of posterior coxa, third and fourth segments very short, together distinctly shorter than one-half the length of second segment (except in *distinctus* and *balloui*, n. spp.); antennal segment II of moderate length, not twice as long as I.

The bicolorous combination of orange to yellow with black to caerulescent black seems characteristic of the genus. Judged from the material studied the color pattern for each species is remarkably stable. The male genitalia are conspicuous and provide valuable characters for distinguishing species.

The oldest named species now included in *Tenthecoris* is *generosus*, a Mexican species that was described by Stål (*10*, p. 323) as an *Eccritotarsus* in 1862. Distant described *E. vestitus* in 1884 from Guatemala (*2*, p. 284) and *E. exitiosus* in 1889 from Trinidad (*3*, p. 202). Both species belong to *Tenthecoris*. In 1902 Reuter (*5*, p. 157) described *E. orchidearum* from Brazil and noted its similarity to *E. vestitus* and *E. exitiosus* of Distant without mentioning the genus *Tenthecoris*. Distant (*4*, p. 202) was the first to recognize *Tenthecoris* when in 1904 he published the following statement: "*Tenthecoris*, Scott is very closely allied to *Eccritotarsus*, Stål. It is described as an orchid pest, as is also *Eccritotarsus exitiosus* Distant and *E. orchidearum* Reuter. *T. bicolor* is very closely allied by description to Reuter's species."

In 1907 Reuter (*6*, p. 253) appears to have first become aware of the identity of *Tenthecoris bicolor*. At this time he synonymized *E. orchidearum* (synonymy is question in discussion for *T. bicolor*, p. 70) with *T. bicolor* and transferred *E. generosus* Stål (*7*, p. 154) to *Tenthecoris*.

In 1942 Costa Lima (*1*, p. 100) published a review of the literature pertaining to *T. bicolor* and provided illustrations suitable for its identification. As noted above, Distant had remarked that *exitiosus* was "very closely allied by description"; however, Costa Lima was the first to use the combination *Tenthecoris exitiosus*.

Thus it is seen that prior to the present paper *Tenthecoris* contained three species, viz., *bicolor* Scott, *exitiosus* (Distant), and *generosus* (Stål). One additional species, *Eccritotarsus vestitus* Distant is here transferred for the first time to *Tenthecoris*. Seven additional species, which we believe to be new, have been found in the collection of

[1] Received November 18, 1946.

[2] In a paper by the senior author (Proc. Ent. Soc. Washington **49**(2): 59–62. 1947) it is pointed out, however, that seven of Stål's original species must remain in *Eccritotarsus*.

Neotropical Miridae in the United States National Museum. These new species are described below. It is regretted that the locality data on many of the specimens are incomplete. In all instances the data are believed to be accurate so far as they are available; however, it is seldom that more than the country is provided. This study is primarily based on material intercepted in quarantine and, while the locality data in many cases are of necessity general, host data are usually complete.

Tenthecoris confusus, n. sp.

Figs. 5, 19

Male.—Body ovate, length 4.6 mm, width 2.19 mm, reddish, with antennae, tibiae, scutellum, and inner half of hemelytra dark (dark area on dorsum with bluish luster), clothed densely with short simple flavous pubescence.

Head subvertical, width across eyes 1.12 mm, length seen from above 0.39 mm, height seen from side 0.9 mm; vertex somewhat flat, width 0.69 mm, frons slightly convex, clypeus moderately prominent, discrete from frons just below line drawn between the bases of antennae, apical one-third dark. Eyes not touching apex of pronotum, seen from side reniform, occupying nearly one-half the height of head. Rostrum length 1.75 mm, surpassing apex of posterior coxa, length of segments, I:II:III:IV::0.67 mm:0.73 mm:0.21 mm:0.13 mm, segment I thickest, II slenderer, compressed, III thicker than II, IV somewhat cone-formed.

Antennae dark, linear, inserted near apex of interior margin of eye, length of segments, I:II:III:IV::0.68 mm:0.85 mm:0.60 mm:0.7 mm, segment I gradually thickened toward apex, II linear, as thick as I at middle, III much slenderer than II, IV slenderer than III, extreme base of I, III and IV luteus.

Pronotum finely punctate, length 0.88 mm, width at base 1.59 mm, at apex 0.83 mm, apical margin slightly sinuate, lateral margin strongly impressed behind callus, posterior margin nearly straight or very slightly sinuate before scutellum, humeral angle broadly rounded. Scutellum triangular, with a large triangular depression at base, dark, extreme base reddish, length 0.56 mm, width at base 0.6 mm, mesoscutum reddish.

Hemelytra smooth, embolar margin convex, thickened, length 2.15 mm, corium with inner angle broadly dark, exterior margin of the dark area forming a straight line subparallel to emboliar margin, clavus dark (except basal one-fourth), cuneus declivent, length 0.86, width at base 0.73 mm, membrane dark, finely rugulose, apical margin luteus.

Gula, xyphus, anterior portion of propleura, metapleura, and posterior coxa tending to luteous. Legs comparatively short, length of posterior femur 1.51 mm, posterior tibia 1.72 mm, all tibiae dark, tarsi pale tending to fuscous at apex.

Male genitalia distinct, with a broad central portion, bearing a spinose process on left apical angle and a larger armlike process on right apical angle, the latter process turned abruptly downward at apical third; right paramere broad and long, with a tubercle at apical one-third, apex broadened, spoon-formed.

Female.—Similar to male in size and coloration, second antennal segment shorter than that in male. Body length 4.99 mm, width 2.32 mm; width of head across eyes 1.16 mm, width of vertex 0.65 mm; length of antennal segments, I:II::0.69 mm:0.86 mm (II and IV missing).

This species is closely related to *vestitus* (Distant); however, the male genitalia and the dorsal coloration readily separate them.

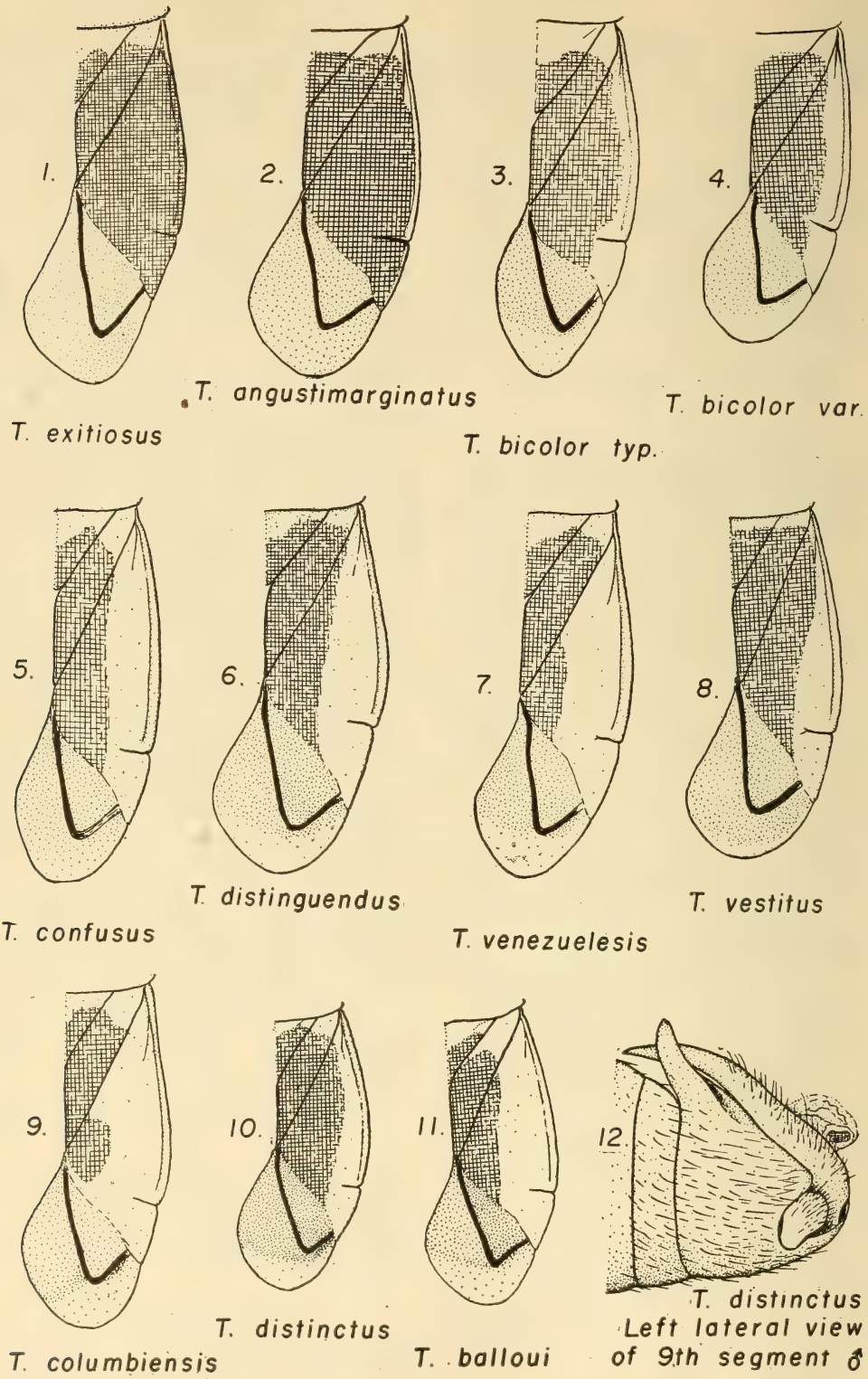
Type material.—Holotype: Male, Mexico, on orchids, intercepted at Washington, D. C., September 6, 1939, U.S.N.M. no. 58156. Allotype: Female, Mexico, on orchids, intercepted at San Francisco, Calif., May 13, 1938. Paratypes: Veracruz, Mexico, May (1). Guatemala, on *Cattleya*, intercepted at San Francisco, September 1, 1938 (1). Costa Rica, in packing of orchids, intercepted at Washington, D. C., October 4, 1933 (1). Venezuela, on *Cattleya*, intercepted at Hoboken, N. Y. (1).

Tenthecoris angustimarginatus, n. sp.

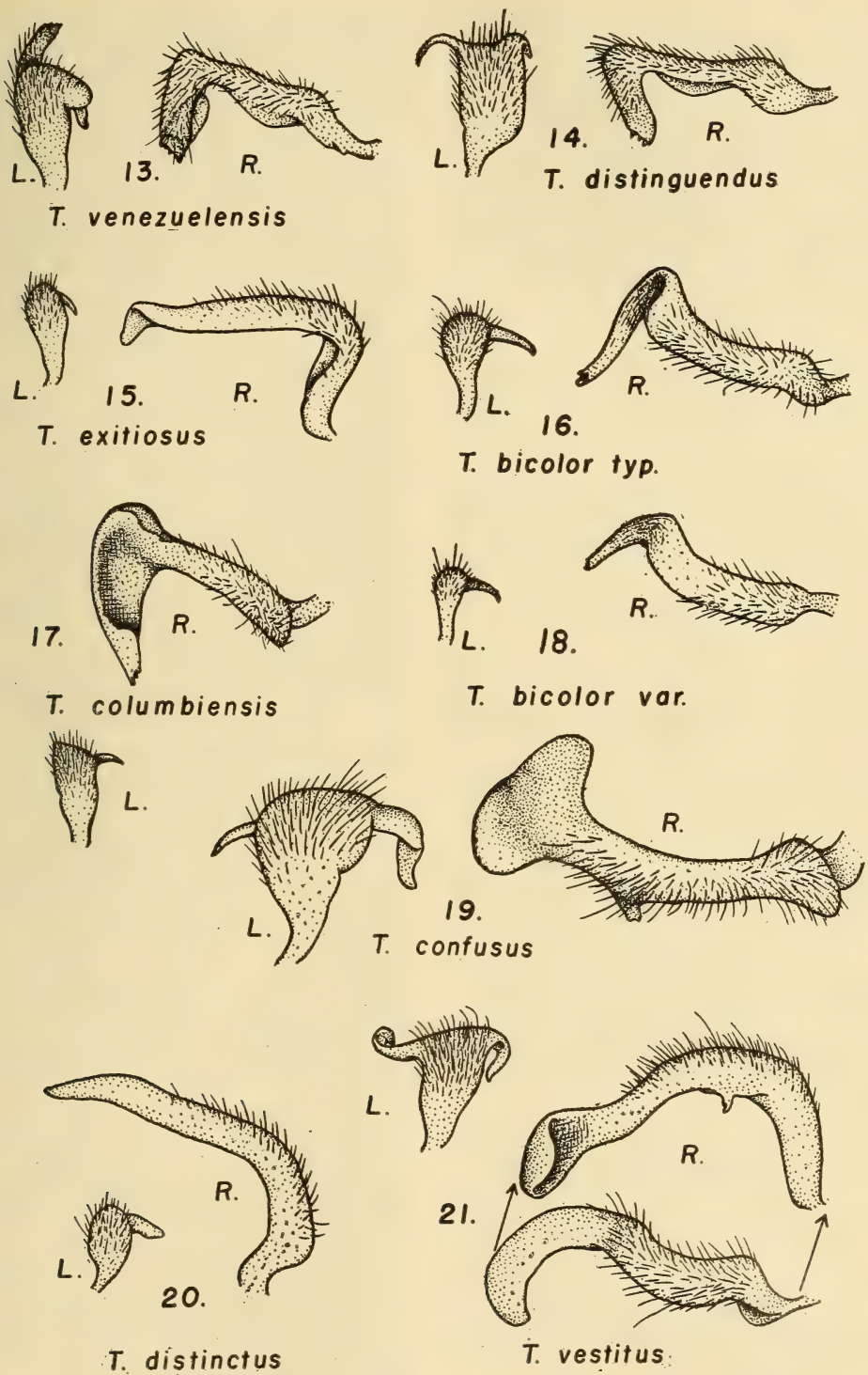
Fig. 2

This species is similar in appearance to *T. exitiosus* (Distant) but can be distinguished by the brownish-red costal margin of the corium and by the relatively shorter second antennal segment.

Female.—Length 4.35 mm, width 2.17 mm. Antennae and tibiae black; scutellum, except for median triangular area, and corium, except for narrow margin along costa, black with violaceous reflections; membrane concolorous,



FIGS. 1–11.—Indications of the color pattern of the hemelytra and the scutellum in species of *Tenthecoris*. FIG. 12.—As indicated.



FIGS. 13–21.—Left (L) and right (R) parameres in species of *Tenthecoris*. In each case an outside view (relative to normal position on the ninth segment) is shown. In the case of Fig. 21 a lateral view of the right paramere is also shown.

dark; remainder of body reddish brown to ochraceous.

Head, width across eyes 1.12 mm, length seen from above 0.42 mm, height seen from side 0.91 mm; vertex width 0.7 mm, slightly convex. Rostrum surpassing apex of hind coxae, length of segments, I:II:III:IV::0.84 mm: 0.73 mm:0.21 mm:0.14 mm. Antennae black except extreme base of segment I, apical three segments becoming somewhat lighter; length of segments, I:II:III:IV::0.64 mm:0.73 mm: 0.49 mm:0.56 mm.

The structural affinities of the female specimens indicate close relationship to *vestitus;* however, examination of the male genitalia will be necessary to establish this association definitely.

Type material.—Holotype: Female, Tamazunchale, San Luis Potosí, Mexico, intercepted at Laredo, Tex., August 10, 1946, on orchids, U.S.N.M. no. 58157. Paratype: Same data (1).

Tenthecoris distinguendus, n. sp.

Figs. 6, 14

Male.—Body reddish ochraceous, with dark markings and pubescence similar to those in *confusus*, n. sp.; length 4.73 mm, width 2.32 mm.

Head width across eyes 1.12 mm, length seen from above 0.43 mm, height seen from side 0.86 mm; vertex width 0.69 mm, compared with *confusus* the vertex is more convex, frons less convex and the clypeus with base lower and darker at apex. Rostrum reaching apex of posterior coxa, length of segments, I:II:III:IV:: 0.77 mm:0.7 mm:0.21 mm:0.14 mm.

Antennae, length of segments, I:II:III: IV::0.65 mm:0.85 mm:0.47 mm:0.47 mm, entirely dark except extreme base of I. Length of posterior femur 1.51 mm, tibia 1.72 mm, tarsi fuscous.

Male genitalia distinct, right paramere bent at right angle at middle, broader at base, left paramere short, left process long; left margin of ninth abdominal segment strongly impressed to receive the apical portion of right paramere.

Female.—Similar to male. Body length 4.6 mm, width 2.37 mm. Width of head across eyes 1.19 mm, width of vertex 0.65 mm. Length of antennal segments, I:II:III:IV::0.7 mm:0.86 mm:0.56 mm:0.49 mm.

Structurally this species is closely related to *venezuelensis*, n. sp.; however, the color pattern resembles that of *confusus*, n. sp. As indicated in the key the shape of the lateral basal angles of the dark area on the scutellum and hemelytra provides the most apparent difference.

Type material.—Holotype: Male, San Pedro de Montes de Oca, Costa Rica, October 19, 1935, by S. and C. Ballou on *Epidendrum* sp., U.S.N.M. no. 58162. Allotype: Female, same data. Paratypes: Same data (4). Same locality, collected December 7, 1935, by C. H. Ballou (1).

Tenthecoris venezuelensis, n. sp.

Figs. 7, 13

Male.—Body ovate, length 4.04 mm, width 2.02 mm, ochraceous, with dark markings on dorsum similar to those on *confusus*, n. sp., but occupying less area on the corium, this area restricted to the inner apical angle of the corium, not extending basally beyond apical third of the claval suture; exterior margin not forming a straight line. Legs entirely (except tip of third tarsal segment) and basal two-fifths of antennal segment I pale.

Head, width across eyes 10.8 mm, length seen from above 0.3 mm, height seen from side 0.77 mm; vertex width 0.65 mm, slightly convex; frons a little less convex than that on *distinguendus*, n. sp. Rostrum reaching apex of posterior coxa, length of segments, I:II:III:IV:: 0.63 mm:0.7 mm:0.21 mm:0.3 mm.

Antennae dark except basal two-fifths of segment I, length of segments, I:II:III:IV::0.56 mm:0.57 mm:0.49 mm:0.5 mm.

Male genitalia similar to those of *distinguendus*, n. sp.

Female.—Similar to male, body length 4.39 mm, width 2.15 mm. Width of head across eyes 1.08 mm, width of vertex 0.68 mm. Length of antennal segments, I:II:III:IV::0.56 mm: 0.69 mm:0.47 mm:0.56 mm.

This species is very close to *bicolor* Scott but can be distinguished by its pale tibiae, more restricted dorsal coloration, and different structure of male genitalia.

Type material.—Holotype: Male, Venezuela, December 1918, collected by H. Pittier on orchids, U.S.N.M. no. 58158. Allotype: Female, same data. Paratypes: Same data (9). Caracas, Venezuela, May 27, 1941, collected by C. H. Ballou on *Cattleya labiada* (5). Caracas, Venezuela, intercepted at Washington, D. C., September 1933, on *Cattleya* plants (4). El Valle,

Venezuela, May 27, 1941, collected by C. H. Ballou on *Cattleya labiada* (1). Venezuela, intercepted at Washington, D. C., on orchids: 1933, December 8 (1); 1934, October 19 (2); 1936, June 19 (3), August 1 (6); 1937, May 28 (1), June 14 (1), July 7 (2), 15 (2), August 12 (1), November 14 (1); 1938, May 12 (2), June 12 (2), 16 (2), September 9 (2); 1939, May 2 (4), June 20 (1), July 26 (1), September 14 (1); 1940, March 25 (1); 1941, August 18 (1). Venezuela, intercepted at New York City, New York, on orchids: 1914, May 29 (1); 1915, February 2 (1); 1939, April 12 (2); 1940, February 13 (6), May 16 (1). Venezuela, intercepted at Hoboken, N. J.,on orchids: 1941, April 30 (2), August 18 (1); 1942, September 28 (1); 1943, November 4 (2); 1946, May 21 (1). Venezuela, intercepted at San Juan, Puerto Rico, on orchids: 1937, July 1 (1), November 12 (1); 1938, May 6 (1); 1940, May 20 (1). Venezuela, intercepted at San Francisco, Calif., on orchid: 1936, March 30 (1). Columbia, intercepted at Washington, D. C., on orchid: 1937, May 29 (2). Colombia, intercepted at San Francisco, on orchid: 1939, August 1 (1). Brazil, intercepted at Hoboken, N. J., on *Cattleya:* 1942, September 28 (2).

Tenthecoris colombiensis, n. sp.
Figs. 9, 17

The coloration of this species is similar to that of *venezuelensis*, n. sp., except that antennal segment III is pale. The antennal segment II is longer and the male genitalia are distinct.

Male.—Body length 4.52 mm, width 2.06 mm; head with 1.16 mm, length seen from above 0.43 mm, height seen from side 0.95 mm, vertex width 0.73 mm. Rostrum surpassing apex of posterior coxa, length of segments, I:II:III:IV::0.85 mm:0.94 mm:0.24 mm: 0.14 mm.

Antennae dark, base of segment I and segment III pale, length of segments, I:II:III: IV::0.59 mm:1.02 mm:0.71 mm:0.73 mm.

Male genitalia nearest *bicolor,* right paramere greatly expanded at apex, left paramere of the one-armed type also exhibited by *exitiosus* and *bicolor*. Ninth abdominal segment without tubercle at the left dorsolateral angle.

Female.—Similar to male, body length 5.16 mm, width 2.32 mm; width of head across eyes 1.2 mm, width of vertex 0.73 mm. Length of antennal segments, I:II:III:IV::0.6 mm:1.0 mm:0.68 mm:0.77 mm. Segment II not distinctly shorter than that of male.

Type material.—Holotype: Male, Colombia, intercepted at Washington, D. C., October 7, 1937, on *Cattleya,* U.S.N.M. no. 58159. Allotype: Female, same data, November 14, 1936. Paratypes: Same data, May 28, 1937 (4). Same data, October 1, 1937 (1). Same data, October 28, 1936 (1). Colombia, July 17, 1917, collected by H. E. Dietz from orchid (1). Colombia, intercepted at New York City, N. Y. (1).

Tenthecoris distinctus, n. sp.
Figs. 10, 12, 20

Male.—Body ovate, length 3.66 mm, width 1.85 mm, shining, reddish with dark on dorsum, densely clothed with fine, simple, flavous pubescence.

Head subvertical, width across eyes 0.80 mm, length seen from above 0.3 mm, height seen from side, from vertex to apex of clypeus, 0.86 mm. Vertex width 0.47 mm, slightly rounded, frons slightly convex, clypeus moderately prominent, slightly curvate, discrete from frons at base, base situated on a line connecting lower margins of eyes. Eyes seen from side reniform, occupying about one-half the height of head. Rostrum short, not reaching apex of intermediate coxa, length of segments, I:II: III:IV::0.17 mm:0.29 mm:0.14 mm:0.08 mm.

Antennae linear, inserted above apex of interior margin of eye, length of segments, I:II:III:IV::0.42 mm:0.53 mm:0.56 mm: 0.55 mm, segment I constricted at base, ochraceous, fuscous at apex, II black, III and IV dark but paler than II.

Pronotum finely distinctly punctate, length 0.98 mm, width at base 1.33 mm, at apex 0.56 mm, lateral margin nearly straight, posterior margin sinuate before scutellum, humeral angle broadly rounded. Scutellum black, triangular, length 0.47 mm, width at base 0.70 mm, with a median triangular impression at base.

Hemelytra with embolar margin thickened, slightly convex, length 1.72 mm; clavus black except extreme base; corium black with exterior margin broadly reddish, red area broadened posteriorly; cuneus triangular, length 0.6 mm, width at base 0.73 mm, cuneal fracture deep, membrane hyaline, cellular area black.

Body beneath with xyphus and propleura tending to flavous. Legs moderately long, anterior and intermediate tibiae, apex of posterior

tibia and all tarsi flavous; length of posterior femur 1.12 mm, posterior tibia 1.29 mm, anterior surface of posterior femur mottled with flavous spots.

Male genitalia very distinct, right paramere long, slender, and curved, fitting left dorsal margin of ninth abdominal segment which has a spinelike process at base, apex pointed; left paramere small, knoblike, of the one-armed type; arm not spinose.

Female.—Similar to male, body length 3.78 mm, width 2.02 mm. Length of antennal segments, I:II:III:IV::0.42 mm:0.6 mm:0.56 mm:0.53 mm.

This species is not altogether characteristic of the genus. Its body form, structure of head and pronotum, and bicolorous pattern undoubtedly place it as a member of *Tenthecoris;* however, its distinctly smaller size, considerably shorter rostrum of which the segments II and III taken together are longer than one-half the length of segment II and the distinctive male terminalia set *distinctus* apart from the other species. The long spinose process of the left dorsolateral angle of the ninth abdominal segment is suggestive of *Caulotops.*

Type material.—Holotype: Male, Guatemala, intercepted at San Francisco, Calif., March 1, 1944, on *Odontoglossum bictoniense,* U.S.N.M. no. 58160. Allotype: Female, same data, on *Odontoglossum grande.* Paratypes: Same data, on *O. bictoniense* (12). Same data, on *O. grande* (2). Same data, April 13, 1944, on *Oncidium leucochilum* (2). Guatemala, intercepted at Washington, D. C., on *Ocineta oeusa,* November 10, 1937 (1). Guatemala, intercepted at New York City, N. Y., on orchids, November 9, 1935 (1). Guatemala, intercepted at New Orleans, La., on orchids, January 30, 1941 (2). Guatemala, intercepted at New Orleans on *Primavera* log, February 3, 1941 (1). Guatemala, intercepted at Washington, D. C., on *Lycaste,* October 25, 1938 (1). Guatemala, intercepted at Honolulu, T. H., July 7, 1936 (2). Mexico, intercepted at Laredo, Tex., on orchids, October 30, 1941 (2). Tamazunchale, San Luis Potosí, Mexico, intercepted at Laredo, Tex., August 10, 1946, on orchid plants (5).

Tenthecoris balloui, n. sp.

Fig. 11

This species is similar to *T. distinctus,* n. sp., in its size and length of rostrum, but can be distinguished by the different color pattern. Dark area on corium occupying less than the inner half; the anterior margin of the dark area on hemelytra not forming a straight line. Basal dark annulation on antennal segment I more distinct. Clypeus more curvate, and apices of tarsi tending to fuscous.

Female.—Body, length 3.44 mm, width 1.98 mm. Head across eyes 0.86 mm, length, seen from above, 0.3 mm, height, seen from side, 1.08 mm; width of vertex 0.52 mm. Rostrum scarcely reaching middle of intermediate coxae, length 0.95 mm. Length of antennal segments, I:II::0.43 mm:0.65 mm (III and IV missing).

This species is named in honor of C. H. Ballou whose activities as a collector have aided greatly in increasing our knowledge of the Neotropical fauna.

Type material.—Holotype: Female, Medellin, Colombia, March 29, 1930, collected by S. and C. H. Ballou on *Cattleya gigas,* U.S.N.M. no. 58161. Paratypes: Same data (7).

Tenthecoris bicolor Scott

Figs. 3, 4, 16, 18

Tenthecoris bicolor Scott, Ent. Monthly Mag. **23**: 64–66. 1886.

Judged from the source of specimens intercepted at various United States ports, this species is restricted to Brazil. The only specific locality from which *T. bicolor* has been received is Santos, São Paulo. All other specimens except one are recorded as "Brazil on cattleya." Most of these were intercepted at Hoboken.

There is considerable variation among the specimens of different series, but since the exact locality of origin is not known it is not possible to know if this variation is correlated with geographical distribution. The degree of variation may be seen by comparing Figs. 3 and 16 with 4 and 18. The former, from "Santos," represent the form accepted here as typical since it seems to agree most closely with Scott's original description; length 4.5 mm. The latter figures represent a slightly smaller and lighter form; length 4.0 mm. One specimen bears determination labels as follows: "Spec. typ. *Eccritotarsus orchidearum* Reut." and "*Tenthecoris bicolor* Scott O. M. Reuter det." This is a female specimen as large as the largest examples among the 33 specimens studied. The reddish margins of the hemelytra are wider and more discrete than

in the other specimens while the dark portion of the corium and clavus lacks the pronounced metallic blue reflection exhibited by typical form. The median line of the scutellum which is marked with reddish to the apex, is also unusual even for a teneral specimen. It seems very likely that this specimen represents a distinct species, in which case Reuter's name *orchidearum* will have to be restored. The final decision in this matter must wait study of male examples.

Type material.—Not seen. Should be in the British Museum (Natural History), London. Described from "specimens" taken alive in England "on leaves of an orchid from Bahia."

Tenthecoris vestitus (Distant), n. comb.

Figs. 8, 21

Eccritotarsus vestitus Distant, Biologia Centrali-Americana, Rhynchota, Hemipt.-Heteropt., **1**: 284, pl. 28, fig. 2. 1884.

Twenty-five specimens of this species have been studied. Of these, 24 were intercepted on Orchidaceae originating in Guatemala. One specimen indicates Nicaragua as locality of origin. The interceptions were made at the ports of San Francisco, Calif., New York, N. Y., Hoboken, N. J., and Washington, D. C. Besides "on orchids," *Laelia superbiens* and *Oncidium* sp. have been reported as host plants.

The species shows considerable size variation, ranging from 3.75 mm to 5.10 mm within the same sex (♂).

Type material.—Not seen; should be located in the British Museum (Natural History), London. Described from "Guatemala, Pantaleon." Number of specimens not indicated.

Tenthecoris exitiosus (Distant)

Figs. 1, 15

Eccritotarsus exitiosus Distant, Ent. Monthly Mag. **25**: 202. 1889.
Tenthecoris exitiosus, Costa Lima, Orquidea **4** (31): 100. 1942.

Fifty specimens of this species have been examined. With the exception of two specimens collected at Port of Spain, Trinidad, February 20, 1895, by T. J. Potter, on orchids, all bear labels indicating "Colombia" as country of origin. The specimens have been intercepted at the ports of Washington, D. C., San Francisco, Calif., and Hoboken, N. J., with the exception of two taken at "Medellin, Colombia," March 29, 1930, by S. and C. H. Ballou, on *Cattleya gigas*. Several of the intercepted specimens also bear labels indicating *Cattleya gigas* as a host plant. The remainder refer either to "*Cattleya* sp." or "orchids."

This is a strikingly distinct species having the hemelytra and corium, with the exception of a narrow basal area, black with metallic-blue reflections. Pronotum and head orange-red; apex of the hind femora, hind, middle, and apical fourth of fore tibiae black. Apical half of tylus black; two basal segments of antennae black, apical two white.

Length varies in specimens at hand from 3.75 mm to 4.9 mm.

Type material.—Not seen. Should be in the British Museum (Natural History), London. Described from "some specimens" originating in the "Botanical Gardens at Trinidad," where they were reported as doing much damage.

Tenthecoris generosus (Stål)

Eccritotarsus generosus Stål, Stettin Ent. Zeit. **7** (7–9): 323. 1862.
Tenthecoris generosus, Reuter, Zeitschr. Wiss. Insektenbiol. **3**: 253. 1907.

No examples of this species have been studied. Stål's description indicates that the second antennal segment of this species is unusually long. Reuter also mentioned this structure, though it is not known that he saw Stål's type specimen. Distant's illustration of the type specimen (2, p. 284, tab. 22, fig. 24) indicates a superficial resemblance to *T. exitiosus*.

Type material.—Not seen. Should be in Naturhistoriska Riksmuseet, Stockholm. Described by Stål from one male specimen received from Mexico.

NOTE CONCERNING ILLUSTRATIONS

The accompanying figures of the hemelytra are intended to be accurate only so far as color pattern is concerned. These were drawn from the insect, and other details, to a considerable degree, depend upon the angle from which the wing was viewed. The claspers must also be considered as diagrammatic. In comparing claspers with these illustrations it is best to place the entire ninth segment of the abdomen in KOH until the muscle tissue is dissolved sufficiently to allow easy dissection. The claspers should then be placed in glycerin

and studied without a cover glass as it is necessary to move the parts about in order to view them in approximately the position figured.

KEY TO SPECIES

1. Rostrum scarcely reaching apices of intermediate coxae; smaller species (less than 4 mm. in length) 2
   Rostrum reaching or surpassing apices of posterior coxae; larger species (more than 4 mm in length) 3
2. Dark area of corium throughout two-thirds of its length equal to or exceeding width of clavus ..... *distinctus*, n. sp.
   Dark area of corium equaling width of clavus only at apex of clavus ..... *balloui*, n. sp.
3. Hemelytra entirely dark (except the extreme base) 4
   Hemelytra with lateral margin reddish or ochraceous 5
4. Antennal segment II about twice as long as I. *generosus* (Stål)
   Antennal segment II much less than twice the length of I ..... *exitiosus* (Distant)
5. Tibiae dark or with dark markings 6
   Tibiae without dark markings 8
6. Pale margin of hemelytra with greatest width usually less, never more than length of cuneal fracture (see Figs. 3 and 4) 7
   Pale margin of hemelytra with greatest width exceeding length of cuneal fracture (see Figs. 5, 3, and 8) 8
7. Cuneus dark except for extreme lateral margin ..... *angustimarginatus*, n. sp.
   Cuneus yellowish red to reddish .. *bicolor* Scott
8. Dark area on corium occupying much less than inner half of corium; pale portion of corium with sides almost parallel or gradually narrowed toward base; clypeus distinctly fuscous 9
   Dark area on corium occupying nearly inner half of corium; pale portion of corium noticeably narrowed along basal third; clypeus not distinctly fuscous.
   vestitus (Distant), n. comb.
9. Basal margin of dark area on scutellum and clavus nearly on a straight line; basal margin of dark area on clavus and lateral margin of dark area on corium forming approximately a right angle.
   distinguendus, n. sp.
   Basal margin of dark area on clavus distinctly distad to that on scutellum, and forming, with lateral margin of dark area on corium, an obtuse angle of approximately 135°.
   confusus, n. sp.
10. Antennal segment II longer than width of vertex plus an eye; segment III distinctly paler than IV ..... *colombiensis*, n. sp.
    Antennal segment II shorter than width of vertex plus an eye; segment III not distinctly paler than IV ... *venezuelensis*, n. sp.

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ETHNOLOGY.—*An early Cherokee ethnobotanical note.*[1] JOHN WITTHOFT, University of Michigan. (Communicated by W. N. FENTON.)

Most of the published Cherokee ethnobotanical data have been drawn from the Cherokee communities still resident in western North Carolina. These Cherokee belong to the so-called Middle Dialect group; almost nothing is known of the ethnobotany, or indeed, of any traditional material, from other Cherokee groups. The small amount of data on Oklahoma Cherokee herbalism collected by Dr. John R. Swanton from Indians of Natchez descent living among the Oklahoma Cherokee agrees neither in usage nor native names with other published Cherokee material or with recent data from Qualla Reservation, North Carolina.[2] Thus it is especially gratifying to find an early, if brief, account of plant usage among the Cherokee of the Western, Mountain, or Upper Dialect group, written prior to their removal to Indian Territory.

John Gambold was a Moravian minister who served as a missionary to the Cherokee at Spring Place on the Conasauga River (now in northwestern Georgia) from 1805 to 1825. His wife, Anna Rosina Gambold, was a botanist and one of Henry Muhlenberg's correspondents. Her notes and herbarium specimens contributed much to early botanists' knowledge of the Cherokee country.[3] Henry Steinhauer, a botanist who visited Spring Place about 1817, wrote with admiration of Mrs. Gambold's botanical and ethnological collections.[4] It is probably too much to hope that such an important herbarium and series of ethnological material should still be in existence, but letters and other manuscripts containing ethnographic data may have survived, awaiting discovery by some student of southern botany. A Gambold manuscript, apparently found among Muhlenberg's papers, was published in 1818, and includes a list of plants found in the vicinity of Spring Place and notes on the Indian utilization of certain of these plants.[5] Several of the usages noted by Mrs. Gambold are known to my informants at Qualla Reservation; the other plants, when utilized, are employed for entirely different purposes. Unfortunately, so little is known about Oklahoma Cherokee ethnology that no comparison with modern Western Cherokee traditions is possible. The following series of notes is copied from Mrs. Gambold's article; the common and scientific names of the plants have been changed to a more modern terminology.[6]

Red maple, *Acer rubrum* L. "The inner bark boiled to a syrup, made into pills, and these dissolved in water, is used in case of sore eyes; the eyes washed therewith."

Black cohosh, *Cimicifuga racemosa* (L.) Nutt. "The root in spirits, these made use of in

[1] Received December 23, 1946

[2] SWANTON, JOHN R. *Religious beliefs and medical practices of the Creek Indians.* 42nd Ann. Rep. Bur. Amer. Ethnol.: 666–670. 1928. Also scattered notes in the published works of James Mooney and Franz Olbrechts, manuscript field notes of James Mooney in the archives of the Bureau of American Ethnology, and data from my current field studies of Cherokee ethnobotany.

[3] BARNHART, JOHN HENDLEY. *The botanical correspondents of Schweinitz.* Bartonia **16**: 26. 1934.

[4] *Ibid.*, p. 26.

[5] GAMBOLD, MRS. ANNA. *Plants of the Cherokee Country. A list of plants found in the neighborhood of Connasarga River (Cherokee Country), where Springfield is situated.* Amer. Journ. Sci. (Silliman's Journ.) **1**: 245–251. 1818.

[6] *Ibid.*, pp. 250–251. The Latin names used are those of the 7th edition of Gray's *Manual*, but Small's *Manual of the southeastern flora*, New York, 1933, was consulted to check the ranges and identifications.

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rheumatic pains."

Maidenhair fern, *Adiantum pedatum* L. "A decoction of the whole plant, used as an emetic in cases of ague and fever. A very strong medicine."

Buckeye, *Aesculus* sp. "The nuts, pounded, are used in poultices."

False aloe, *Agave virginica* L. "The root is chewed in obstinate cases of diarrhoea with wonderful success. It is, however, a very strong medicine."

Onion, *Allium* spp. "The Indians are fond of, for culinary purposes."

Angelica, *Angelica* sp. "The same."

Pawpaw, *Asimina triloba* (L.) Dunal. "Of the bark they make very strong ropes."[7]

Hercules-club, devils-walkingstick, *Aralia spinosa* L. "A decoction of the roots roasted and pounded (green, they are poisonous), is given as an emetic. A very strong one."

Wild ginger, *Asarum* sp. "The leaves dried and pounded, are used for snuff; fresh, they are applied to wounds."

Crossvine, *Bignonia capreolata* L. "Tea made of the leaves cleanses the blood."

Strawberry shrub, *Calycanthus floridus* L. "The *roots* are used as (though very strong) emetics. The *seeds* to poison wolves."

Thistle, *Cirsium* spp. "Various species. The roots used in poultices."

Redbud, *Cercis canadensis* L. "Children are fond of eating the blossoms."

Tickseed, *Coreopsis* sp. "The whole plant is much used in coloring. It affords a *red* color."

Dogwood, *Cornus florida* L. "The bark of the root is used to heal wounds, and in poultices."

American holly, *Ilex opaca* Ait. "Of the wood, spoons are made. The berries of use in colics." The Qualla Cherokee use Rhododendron wood for spoons.

Butternut, *Juglans cinerea* L. "A kind of pills are prepared from the inner bark, and used as a cathartic." Mountain Whites in western North Carolina boil the bark of the butternut (and sometimes walnut) into a thick sediment, which is rolled into pills to be used as a cathartic and "spring tonic." The Qualla Cherokee consider these barks too strong for internal medicinal usage and do not use this recipe, although the method of preparation is reminiscent of the Cherokee method of "boiling down" herbs.

Sweetgum, *Liquidambar styraciflua* L. "The gum is used for a drawing plaster. Of the *inner* bark a tea is made for nervous patients."

Tuliptree, *Liriodendren tulipifera* L. "Of the bark of the root a tea is made and given in fevers. It is also used in poultices."

Fly-poison, *Amianthium muscaetoxicum* (Walt.) Gray. "The root is a crow poison; and a sure, but severe cure for the itch."

Pine, *Pinus* spp. "Boil the root, skim off the turpentine, spread it on Deer's skin (tanned) for a drawing plaster."

Mayapple, *Podophyllum peltatum* L. "A sirup is boiled of the root, and given for a purgative, two pills at a time. A drop of the juice of the fresh root in the ear, is a cure for *deafness*. (So I have been told, I never witnessed it.)"

Five-finger, *Potentilla* sp. "A tea of it is given in fevers."

Wild black cherry, *Prunus serotina* Ehrh. "Of the bark a tea is made, and drunk in fevers."

White oak, *Quercus alba* L. "The bark is used for an emetic."

Wild rose, *Rosa* spp. "The roots boiled, and drunk in cases of dysentery."

Tall blackberry, *Rubus* sp. "The root good to chew in coughs."

Bloodroot, *Sanguinaria canadensis* L. "The root is used for the *red* die in basket making." The Qualla Cherokee also use the bloodroot for the same purpose.

Lizardtail, *Saururus cernuus* L. "The roots roasted and mashed, used for poultices."

Nightshade, *Solanum nigrum* L. "When young, made use of as the best relished potherb."

Goldenrod, *Solidago* sp. "A tea much made use of in fevers."

Wild indigo, *Baptisia tinctoria* (L.) R.Br. "A blue die."

Indian pink, *Spigelia marilandica* L. "In cases of worms." This is the general Cherokee and Creek vermifuge.

American ipecac, *Gillenia stipulata* (Muhl.) Trel., and bowmansroot, *G. trifoliata* (L.) Moench. "The whole plant a very good emetic. Of a strong tea or decoction thereof, a pint is drunk at a time."

[7] I know of no ethnographic data on the use of this plant for cordage, but Dr. Volney Jones, of the Ethnobotanical Laboratory, University of Michigan, tells me that examples of cordage made from pawpaw bark are known from several southeastern archeologic sites.

Spiderwort, *Tradescantia* sp. (*virginica* L.) "The leaves much relished greens for the table." This plant is an important green at Qualla.

Adamsneedle, *Yucca filamentosa* L. "The roots pounded and boiled are used instead of soap to wash blankets; likewise to intoxicate fishes, by strewing them pounded on the water. The same is done with Æsculus." The use of *Yucca* as a soporific is widespread in the Southwest, and may have diffused from that direction. The Qualla Cherokee also used buckeye as a fish poison, but *Yucca* is used there only for medicinal purposes.

GEOLOGY.—*Granitization and its significance as a regional metamorphic process in New England.*[1] L. W. CURRIER, U. S. Geological Survey.

In presenting this subject I am taking advantage of the opportunity to set forth a hypothesis and an extrapolation on the results of studies not yet finished. I am deeply conscious of the incompleteness of my own field studies for providing data to support adequately the broad generalization implied by the subject. The thesis, however, is of the sort that requires for its ultimate substantiation facts accumulated from many sources and by many workers. It seems worth while, therefore, to offer a progress report at this time, and to indicate the direction in which a working hypothesis is developing. I am well aware of the ease with which imagination may subtly translate multiple working-hypotheses into a multiply-working hypothesis. I hope this pitfall will be avoided.

Nearly 20 years ago I started rather fitful field observations in the so-called Cambrian and Ordovician terranes of east-central Vermont. In the middle thirties this interest became a planned program under the auspices of the Geological Society of America, and many traverses were made across the Barre, Strafford, Randolph, Woodstock, and Hanover quadrangles. In 1937 a Geological Survey project for the detailed mapping of the Barre quadrangle was started under my general supervision. Shortly after, I was obliged to leave the detailed mapping to my assistant, R. H. Jahns, in order to start another Survey project for the study of commercial granites of New England. Later this project was merged with the Massachusetts cooperative program. In the granite studies I was assisted at various times by H. F. Buie, R. H. Jahns, and N. E. Chute. During the War the regular mapping program and areal studies were suspended, but enough data have been collected by numerous geologists to suggest clearly, it seems to me, a fundamental relation of regional granitic invasion to general metamorphism in New England. In the light of my own observations in central and eastern Vermont, south-central New Hampshire, and Massachusetts supplemented by the study of many thin sections, in the light of the work of a very capable field staff, and in the light of the work of other geologists, especially those who have done such an excellent job of mapping in New Hampshire, I believe that a pattern of igneous and hydrothermal metamorphism is indicated, and that there is a broadly proportional relationship between the manifestations of subjacent igneous invasion and regional metamorphism. In its broadest aspects this thesis is not new; those who have been interested in the literature relating to such problems of metamorphic geology will recall Barrell's paper of 1921.[2]

The granite in northeastern Massachusetts that is known commercially as the "Chelmsford Granite" appears to be an excellent example of the so-called "granitization" process, whereby an "igneous-looking" rock, to use Grout's expression,[3]

[1] Address of the Retiring President of the Geological Society of Washington, presented before the Society on December 12, 1945. Published by permission of the Director of the U. S. Geological Survey. Received December 11, 1946.

[2] BARRELL, JOSEPH, *Relations of subjacent igneous invasion to regional metamorphism.* Amer. Journ. Sci., ser. 5, **1**(1, 3): 174–186, 255–267. Jan. and Mar. 1921.

[3] GROUT, F. F., *Formation of igneous-looking rocks by metasomatism.* Bull. Geol. Soc. Amer. **52**: 1525–1576. Oct. 1941.

has been derived from a previously existing sedimentary rock by a process of metasomatic replacement through the action of solutions derived from a granite magma, or at least a magma that gave rise to alkali-bearing solutions. The mode of origin of this granite seems particularly significant in connection with the general metamorphic problem, and I shall devote the latter part of this paper to a discussion of this formation. Because of its relation to metamorphism it is pertinent to review the so-called "granitization theory," but I shall not dwell on the history of its development because several excellent reviews have appeared in recent years, notably those by MacGregor and Wilson,[4] Rastall,[5] Shand,[6] and Raguin.[7] Also, H. H. Read[8] has traced the development of thought regarding the relation of igneous action to metamorphism. It is interesting to note that in these discussions granitization and metamorphism have become mutually involved, for it seems impossible to divorce the theories of origin of many of the regional gneisses from the theory of "replacement granite."

It is said that the origin of granites is still one of the outstanding problems of geology, despite the fact that granites comprise one of the most widespread and common species of igneous rocks. The problem is now, of course, far beyond its status of 150 years ago, when Hutton's magmatic theory countered Werner's theory of chemical precipitation from sea waters. Hutton's theory won out because it explained adequately certain field relations and structures that the Wernerian theories were totally unable to account for. The granite problem today relates to the sources and derivations of granite magmas, and the modes of emplacement. Among other things, it involves many bodies of granitic rocks whose spatial relations and structures are still not explainable by emplacement of magma in spaces prepared for its reception by crustal displacement, by force of intrusion, or by stoping. It may be objected that such granites are unusual and unconventional, and generally show some degree of foliation or other parallel structure that will place them in the category of gneisses, rather than true granites. But many—probably most—of the so-called "normal" granites possess a parallel structure in greater or less degree, which is variously attributed to shearing, magmatic flow, or internal adjustment to deformation. Granitic gneisses, gneissic granites, and apparently isotropic granites form a perfectly gradational series, and neither the perfection of the layering or banding nor the apparent absence of foliation is a completely serviceable criterion for the mode of origin. Alternation of clearly developed and persistent lithologic layering implies a preexisting structure of the country rock in many instances, but the more thorough and complete the granitization of a preexisting rock, the more obscure are the vestiges of earlier structures and compositions, so that the structural distinction between "orthogneisses" and "paragneisses" ultimately breaks down. The terms *orthogneiss* and *paragneiss*, therefore, beg the question, for often we cannot easily determine how much of a paragneiss may be of magmatic origin, or whether a supposed orthogneiss is in reality preserving a relict structure. The terms "lit-par-lit" and "injection gneiss" have been conveniently used to explain the alternation of feldspathic or granitic layers with micaceous schist layers; for these, the forcible intrusion of magma as thin leaves has been implied, but commonly without any adequate explanation of the mechanical difficulties involved in the process. It is difficult to comprehend how the thin and delicate septa could be so spread apart and still preserve their remarkable continuity and uniformity of thickness. In some places it is obvious that large quantities of material must have been added, but no appreciable or discernible squeezing aside of the country rock formations is indicated; rather, contacts show wide zones of gradation from gneiss to comparatively uninvaded country

[4] MacGregor, Malcolm, and Wilson, Gilbert, *On granitization and associated processes.* Geol. Mag. **76**(6): 193–213. June 1939.

[5] Rastall, R. H., *The granite problem.* Geol. Mag. **2**(1). Jan.–Feb. 1945.

[6] Shand, S. J., *Eruptive rocks*, ed. 2: 214–226. 1943.

[7] Raguin, E., *Problèmes de la geologie du granite.* Rev. Questions Sci., An. 56, s.5, t.1, f-3: 325–360. May 20, 1937.

[8] Read, H. H., *Metamorphism and igneous action.* Pan. Amer. Geol. **72**(4. 5). Nov.–Dec. 1939.

rock. Moreover, the invading material seems commonly to have been controlled by stratigraphic horizons and lithology. Transitions along the strike are seen to be gradual, from sedimentary rocks to rocks of "igneous composition." Lithologic and field relations in many places have demanded an explanation for a volume-for-volume replacement of material without melting of the country rocks or the intrusion of magma. Hence the so-called "granitization theory."

Granitization, therefore, is broadly defined as a process whereby formations have been changed into rocks of granitic composition and texture without passing through a magmatic stage. Some limit it to a process of recrystallization and replacement of sedimentary rocks without melting to any degree. Others broaden it to include conversion of igneous rocks. Still others include conversion of either sedimentary or igneous rocks partly or largely by melting, involving "palingenesis," "syntexis," and "anatexis." In some instances local melting has doubtless taken place, but melting is certainly not necessary to the process of feldspathization. That some of the replacement granites were never in a plastic condition is attested by the consistent preservation of delicate original structures.

A rock is considered to have been "granitized" when it has been so altered that it approaches closely the composition and texture of granite. Relict structures may be lacking in the most highly granitized products, or recognizable with great difficulty. For sedimentary rocks the "paragneisses" present the most obvious evidences of granitic invasion, but in the more completely granitized rocks the evidence is just as impressive. At one end of a continuous series are the finer-grained phyllitic schists, the quartzites, and other rocks of comparable degrees of metamorphism, in which the evidences of hydrothermal alteration may be largely microscopic. These evidences consist of a small amount of feldspathization and tourmalinization. A host of hydrothermal quartz veins may appear in the country rocks. Such, I am inclined to interpret, are the conditions in the low-grade metamorphic zones of east-central Vermont. So granitization, it seems to me, is a poor term by which to describe this broad and general process of *invasive metamorphism* by hydrothermal solutions and other salic magmatic derivatives. It is predominantly a process of feldspathization, and the results range from rocks that in no obvious way resemble granites to others that are distinguished with difficulty from so-called "true granites." There is nothing peculiar or uncommon about the process that would justify discriminating between "granitization" and some other common phases of igneous metamorphism, and the process should not be set apart categorically as one whose manifestations are found only occasionally, or under particularly unusual conditions. If the local rocks were of favorable composition (such as impure arenytes), were porous enough to permit thorough hydrothermal invasion, were situated at strategic points of attack, and if adequate sources of invasive materials were at hand, the result would be a degree of feldspathization so great that a "replacement granite" was formed. To refer to magmatically intruded granites as "normal granites" in contradistinction to replacement granites" is not only to misuse the term "normal" in more senses than one, but, more disastrously, to fail to recognize the common occurrence of an important general process by becoming lost in admiration of a particularly spectacular local phase.

Accounting for the sources of granitizing solutions leads to most interesting speculations and theories, and is indeed a fertile field for the exercise of scientific imagination. In his discussion of Read's papers Rastall says[9]: "It always seems that the least satisfactory part of all this discussion about emanations and mineralizing fluids and the rest of it is that we do not know where they are supposed to come from . . . if these fluids can turn almost anything into a granite, it seems probable that their own composition must be something like granite, and therefore may arise from the lower part of the sial." If they originate from local bodies of granitic magma they fit clearly into the concept of late stage pegmatitic

[9] RASTALL, R. H., *op. cit.*

solutions and emanations, but oftentimes the volume ratios of emanations to local stocks or batholiths do not seem to be consistent or adequate. The same quantitative relationship applies equally well, incidentally, to the local derivation of granitic bodies from basaltic sources unless both of these, too, be referred to the original separation of sial and sima in the earlier stages of the Earth's history.

In his classic granitization papers relating to the rapakivi granites of Finland, Sederholm[10] introduced the term "migmatite" to indicate a mixture of magmatically injected material and layered country rocks. At first he interpreted remelting as the most important aspect of the alteration, but later he found it necessary to broaden the concept of anatexis so as to involve more than a melt. Solutions were necessary and these were "exudates" of magmas. "Banded" gneisses inherited structures from the original rocks in part by a process of resolution and replacement. In the concluding remarks of his 1923 paper he says, "The metamorphism of these rocks has been mainly chemical. A purely mechanical, so-called dynamo-metamorphism has in most cases been of very little importance. Even the oldest volcanic rocks show only the slightest influence of dynamo-metamorphism." Elsewhere in the same paper he says "The main part of the metamorphism has taken place in obvious connection with the eruption of granite; it can be defined as a regional contact-metamorphism." It is interesting to note that Sederholm considered the veined granites, or "arterites," to be connected in origin always with a known and nearby granite, but he also contended, on a quantitative basis, that his feldspathizing "ichor" could not be the same as the residual liquor from locally intruded magmas. For the same area, Holmquist,[11] too, interpreted an invasive flood of solutions with abundant mineralizers; he pointed out that many of the granitic layers and cross-cutting veins rather closely resembled the country rocks in composition, but concluded, rather strangely it seems to me, that there was lateral secretion of the material under local high temperatures and pressures. In 1938 Backlund[12] argued for the metasomatic replacement origin of the rapakivis, and showed that on the basis of porosities and compositions there was no difficulty involved in transforming a Jotnian sandstone into a rapakivi granite by addition of soda, potassium, and alumina up to 20 per cent or even more, and without essential volume change. He concluded that the migrating elements must have passed upward through well-defined diffusion channels. Incidentally he states that the rapakivi granites are among the most radioactive of the granitic rocks. Two of the important points in his discussion are the involvement of natural rock porosities, and the localization of invasion along defined belts with broad diffusion into the adjacent country rocks.

Sederholm was by no means the pioneer in the study of granitization. In particular the French school of the 80's and 90's set forth ideas that are to be considered as granitization theories, though the term itself was not used. Michel-Levy, LaCroix, Barrois, and others studied the granitic rocks of the Pyrenees and elsewhere, and concluded that country rocks were changed chemically by volatiles and solutions, not necessarily involving fusion temperatures, so that the rocks passed through the sequence

sediment→schist→gneiss→granite

with no sharp contacts; thus they established *feldspathization* as an extensive hydrothermal process under the influence of "les cortéges d'emanations," or, as Termier described them, the "colonnes filtrantes." To these rising columns of emanations from great depths Termier attributed not only regional metamorphism, but also igneous intrusion of the magmatic type—an extreme view, even for today! Synclinal depression and melting or remelting were held accountable for the generation

[10] Sederholm, J. J., *On migmatites and associated pre-Cambrian rocks of southwest Finland.* Bull. Comm. Geol. Finlande, nos. 58 (1923), 77 (1926), and 107 (1934).

[11] Holmquist, P. J., *Typen und Nomenklatur der Adergesteine.* Geol. Fören. Stockholm Förh. **43.** 1921.

[12] Backlund, H. G., *The problems of the rapakivi granites.* Journ. Geol. **46**(3): 339–396. Apr.–May 1938.

of magmas and the freeing of hydrothermal solutions.

The sources of feldspathizing or granitizing solutions have been attributed variously, therefore, to deep-seated sialic sources, to melting of rocks depressed deeply under geosynclines, to emanations from local fusions, to emanations from local uprisings of granite magmas, and even to reactivation of connate waters, but there is widespread agreement that, whatever the sources, the effect has been to alter country rocks by replacement without essential volume changes. To students of ore deposits this process is well founded as a principle; the regional application of it implicates much broader tectonic and structural control. There are so many possible, and even probable contributing sources that it is difficult to decide which is probably the most important unless, as Grout indicates, the problem is approached quantitatively. It would seem that in most instances a deeper-seated and more general source than local intrusives is indicated. In the New England area this appears especially patent, for the evidences of feldspathization are very widely spread, and though granitic intrusives are distributed through most of the region, few of them have had more than very slight and local thermal effect. Their distribution and probable similarity in age, however, bespeak a broad, subjacent magmatic source. A general zonal pattern of hydrothermal effects is suggested, not by the distribution of the exposed granite masses, but by the distribution of migmatitic domes, replacement granites, pegmatites, quartz veins, and incipient feldspathization and tourmalinization in rocks of low-grade metamorphism. The time relations, however, appear to be generally similar. Together with the feldspathizing emanations, pegmatites, etc., they appear to have had a common, subjacent, source.

Volume-for-volume replacement demands an exchange of elements, but not in stoichiometrical proportions. Under granitizing invasion there is a fixing of alkalis, silica, and alumina. Bases become fugitive, especially iron and magnesia and to a less extent lime. In the low-grade metamorphic rocks of Vermont there are also evidences that considerable amounts of titanium have been introduced, largely as rutile and titanite. It would be valuable to know more about the traveling propensities of aluminum and titanium, especially in the low-temperature hydrothermal range. The pattern of the metamorphism and the compositions of the rocks suggest that the expelled bases are driven into the adjacent and overlying rocks, which might well account for, or help to account for, the strongly biotitic and garnetiferous aspects of the broad aureoles that so commonly seem to be associated with replacement granites and migmatitic gneisses. Continued expansion of the granitized zone would continue to drive the fleeing bases ahead; ultimately they would become fixed in higher, or outer, and broader zones of lower temperature and pressure, and might well be able to produce or assist in producing the outermost low-grade epidotic and chloritic zones of metamorphism, representing the frontiers of invasion into which the fugitive elements have been driven. Of course this is a highly hypothetical picture, but for New England it appears to have a considerable degree of substantiation in fact.

The criteria of "granitization"—or perhaps it is better to call them the diagnostic features—appear in the many papers that have been written about specific areas. They are summarized in Grout's critical paper of 1941 (*op. cit.*). Time does not permit more than a very brief review of a few of these papers. First, however, I would like to comment briefly on the three general types of evidence.

"Granitization" is fundamentally a field problem, and the most cogent evidence is found in the field relations and the megascopic field lithologic features. They include the spatial relations, areal replacement without proportionate pushing aside of strata, continuity of regional structures into the granitic mass, accordance of country-rock structures with those of the migmatite, accordance in orientation of inclusions with the country rock and with themselves, lithologic similarities between inclusions and country rocks (making due allowance for the greater alteration of the inclusions), gradational boundaries (partic-

ularly along the strike), relict structures (especially those of nonigneous origin, such as drag folds and axial plane schistosity), mineralogic layering that reflects comparatively uniform, parallel, and continuous lithologic layering. All of these conditions are to be found, incidentally, in the Chelmsford granite of Massachusetts. The field study involves very detailed mapping of quarries and other exposures in order to detect and trace relations of structures that could not possibly be attributed to magmatic flow or segregation. In the Chelmsford granite mass, for example, it is possible to identify original bedding, folds, and a superimposed schistosity parallel to the axial planes and consequently at observable angles to the bedding or "banding," yet the mass is so thoroughly granitized that the stone is one of the most successful commercial granites in the country. The granitization occurred subsequently or perhaps nearly coincidentally with the development of schistosity.

The second group of features is petrographic. The predominant texture of the granitized rock is such as can be attributed to metasomatic action according to well-established criteria of replacement. Among these criteria are the usual directional penetrations of some minerals in others, mottled and streaky perthitic penetrations, myrmikitic intergrowths, and streaks of mosaic and uniformly sized quartz grains that may well reflect the original stratification of an arenyte. Porphyroblasts of feldspar are usual in granitized rocks, and give a pseudoporphyritic appearance to the replacement granite; these metasomes are commonly unzoned, except for soda enrichment and an abundance of inclusions in the outer parts. The porphyroblasts also present ragged contacts with the groundmass, although exceptionally large ones are quite euhedral in general outline. Common also are streaks or grains of epidotic minerals, and of chloritic minerals that are not specifically related to biotite as though by alteration, while other mafic minerals are scant or wanting. It should be remembered, however, that the chain of deuteric and succeeding hydromagmatic reactions produces such hydrous minerals during the declining stages of the consolidation of a granite magma. More than one variety of plagioclase as separate entities is highly suggestive of a nonmagmatic origin. Reversal in order of paragenesis among the consitituent minerals, especially the feldspars, from that to be expected of a magma of similar composition as the rock in question, is also suggestive, but it is commonly difficult or impossible to obtain such evidence because granitization is brought about chiefly by the alkaline and siliceous end products of magmatic differentiation. By and large, then, petrographic evidence is a corroborative corollary to field evidence, but is not conclusive in itself, for both the mineral compositions and the textural relations of "magmatic granites" are simulated by hydrothermal replacement.

The third category is chemical analyses. There seem to be few things that arouse the ire and aggressiveness of critics so much as the failure to give chemical analyses, unless it be the author's interpretation of his analyses. And I might add that there are few things that arouse the imaginative faculties of a geologist more than does a series of selected analyses.

Chemical analyses are particularly useful in demonstrating a variability of the replacement granite beyond that ordinarily found in magmatic granites, except of course in the chilled border zones. Such variability is not, however, a real criterion. The comparison is apt to be the less valuable the more perfect the replacement, for, if the process is accomplished by a solution whose composition is closely similar to that of a granite magma—especially of alaskitic type—the approach to complete replacement will tend to reduce the variability and the difference from a "normal" granite. Comparison with the alleged "average analysis" of known granites is generally an unconvincing argument, although it does serve some purpose in demonstrating exceptional or uncommon amounts of some constituents. Indeed, replacement granites may display a remarkable degree of similarity with associated intrusives and of uniformity within themselves. This probably reflects not only the uniformity of the original rock but also the simplicity of

the granitizing solutions. It seems probable, indeed, that although the constituents of the rock are reassembled to form a new suite of minerals, the quantitative change is not necessarily great. As stated earlier, for the rapakivis Backlund rationalized as much as a 20 per cent addition of alkalis and alumina, but probably the additions are seldom so great, though I have no quantitative data at hand to support this statement, except through a comparison of selected analyses of impure sandstones and well-known granites. I suggest an addition of not more than 5 to 10 per cent in most instances, with the principal changes being effected by a loss of a few percent of bases and a gain of a few percent of alkalis and alumina. In the New England area there seems to be consistent addition of soda, for albitization in some degree marks rocks of all grades of metamorphism. Billings[13] notes, too, the introduction of 2 to 3 per cent of potash in high-grade schist in the Franconia region of New Hampshire.

It would be highly illuminating if chemical analyses of the original sediments could be compared with the granitized products. However, analyses of the unaltered or very slightly altered parts of the formations replaced must generally represent parts so remote from the highly granitized area that the significance of the comparison is uncertain. The normal variations in the original compositions of these rocks may well be of the same general order of magnitude as the changes produced by granitization of the same beds elsewhere.

One of the earliest papers published in this country relating closely to the general subject of granitization, though not specifically emphasizing a dominant role for hydrothermal replacement was that by Fenner.[14] This paper should be read by everyone pursuing the subject. In it Fenner describes the finely and evenly banded gneisses. He argued against the possibility that plastic flow produced the elongated structure, and argued for a pronounced fluidity of the invading materials. For part of the complex, at least, he suggests that the attributes of a rigid body were retained and that "the advance of the main body of magma would be preceded by that of a more dilute portion which would be able to impregnate the wall-rock with facility and initiate processes of transformation and solution which the more concentrated body following would carry farther toward completion."

In 1927 Quirke[15] presented before a meeting of the Geological Society of America a description of a migmatized quartzite in the Killarney, Ontario, region which grades along the strike into granite "that is scarcely distinguishable from the once liquid granite of the vicinity." Quirke is said to have given new impetus to the granitization idea in America. At any rate his 1927 paper was startling to many geologists, but since that time the theory has been much more widely invoked.

In 1934 Lamey[16] described metamorphic effects by the Republic granite in northern Michigan, and the transitions

quartzite→gneissoid quartzite→gneiss→gneissic granite, and
argillaceous rocks→alusite-biotite-staurolite-chloritoid-albite schists

This is particularly interesting in the implied relation of chloritoid and staurolite to granitization.

In 1934 A. L. Anderson[17] described the effect of a granodiorite intrusive on quartzite and interpreted the transition

quartzite→porphyritic granite→granite

The granitic mass has a schistose border zone.

Stark[18] (1935) described the replacement

[13] BILLINGS, MARLAND P., *Introduction of potash during regional metamorphism in western New Hampshire.* Bull. Geol. Soc. Amer. **49**(2): 289–302. Feb. 1, 1938.

[14] FENNER, C. N., *The mode of formation of certain gneisses in the Highlands of New Jersey.* Journ. Geol. **22**: 594–612, 694–702. 1914.

[15] QUIRKE, T. T., *Are some intrusions replacement deposits?* (abstract). Bull. Geol. Soc. Amer. **38**: 119–121. Mar. 30, 1927. See also by same author, *Killarney gneisses and migmatites.* Bull. Geol. Soc. Amer. **38**(4): 753–770. Dec. 30, 1927.

[16] LAMEY, C. A., *Some metamorphic effects of the Republic granite.* Journ. Geol. **42**(3): 248–263. Apr.–May 1934.

[17] ANDERSON, A. L., *Contact phenomena associated with the Cassia batholith, Idaho.* Journ. Geol. **42** (4): 276–392. May–June 1934.

[18] STARK, J. T., *Migmatites of the Sawatch Range, Colorado.* Journ. Geol. **43**(1): 1–26. Jan.–Feb. 1935.

migmatitization of large areas of schists bordering the Pikes Peak granite in the Sawatch Range, Colorado. He stressed the porphyroblastic texture of the schist, and the gradation of the granite into a mixed zone of granitic material and biotite-chlorite schist, with most of the biotite and chlorite laminae ending abruptly against the feldspar porphyroblasts.

G. H. Anderson[19] (1937) described the Pellisier granite in the northern part of the Inyo Range, California, and discussed its replacement origin as a result of the intrusion of a massive granite that underlies and forms the core of the Range. Arenytes, argillaceous rocks and volcanics were involved in the transformation. One of his significant points relates to the fugitive nature of the bases, particularly iron; he shows that the iron ranges from about 2.5 per cent in the main body of the granite to 4.5 per cent in the Pellisier granite, and from 5.5 per cent to 9.0 per cent in the overlying schists, the largest percentage being in the argillite that overlies the granite.

In 1941,[20] Grout gave warning to the fast-growing group of proponents of the granitization theory, some of whom, intrigued by the simplicity of a replacement mode of origin for many granitic rocks seemed inclined, he thought, to apply the theory too broadly, or with too scant evidence. He called for more specific data on volume relationships, textures, relict structures, relations to orogeny or other periods of deformation, chemical changes, etc. He makes a most effective plea for definition of terms and abandonment of loose terminology. He gives an imposing list of criteria to be satisfied. The criteria are excellent and the list is surely complete and well worth study by any student of the subject. He seems to be very exacting, however, as to the amount of corroborative evidence required to prove a replacement origin for a granitic mass, and I daresay that if an equivalent degree of evidence were required to prove the conventional intrusive origin of many granite bodies, or their modes of emplacement, or even the shapes of the masses, not a little of our accepted geologic mapping and interpretations would be in the condition of needing subsequent confirmation of preconceived notions. Certainly there are places where, regardless of the completeness of the data obtained in the field, or at least cited by authors—that is to say, the number of criteria satisfied—neither forcible intrusion nor stoping, nor quiet upwelling of magma could be supported by certain inherent structures and relationships. Incidentally, since when have the modes of emplacement and shapes of granite batholiths been unequivocably established?

Some other statements in Grout's paper cannot be passed by without brief comment. If taken judiciously his paper will serve a very useful purpose and be truly helpful. But he says that recent writers assume the process to be established, and carry their idea too far, applying it to masses several miles across. It is my contention that "granitization" is no longer merely an assumed process, but is established by as clear data and as cogent reasoning as the hydrothermal origin of ore deposits was, when it was widely accepted as a sound and established theory. The effects *are* discernible over large areas—they may, indeed, be manifest regionally in all degrees from incipient feldspathization to the formation of "igneous-looking" rocks. It seems to be largely the term "granitization" that offers the quarrel. Actually the process is one of igneous metamorphism in a broad sense, and if it happens that, by a very simple mineralogic change and the operations of a well-established process the resulting rock resembles a granite to a considerable extent, it is because the original composition, texture, and other local geologic conditions were together favorable to that end point. With other rocks to work upon, quite different appearing rocks would have resulted for the most part, although rocks of granitic composition would still be the theoretical end product wherever sialic solutions were the agents.

[19] Anderson, G. H., *Granitization, albitization, and related phenomena in the northern Inyo Range of California-Nevada.* Bull. Geol. Soc. Amer. **48**(1): 1–74. Jan. 1, 1937.

[20] Grout, F. F., *Formation of igneous-looking rocks by metasomatism; a critical review and suggested research.* Bull. Geol. Soc. Amer. **52**(10): 1525–1576. Oct. 1, 1941.

In places the results of intensive granitization are restricted to the shells or aureoles of recognizable magmatic granites that may reasonably be held accountable for the transformation. To require the discovery of a responsible magmatic body, however, is to require fulfillment of an oftentimes unfulfillable condition, besides placing a serious restriction on the exercising of legitimate scientific imagination.

One statement in Grout's paper particularly worries me. At the end of a paragraph that outlines the various steps necessary to prove acceptably a case of granitization, he says, "Finally, there should be a careful discussion by experts in the various branches of geology which might bear on the conclusion." This is a rather formidable prospect, even aside from the mere task of assembling the opinions of such a group of the learned fraternity. Can't you picture an eager, well-trained, and keen-minded young geologist working in an area and finding himself confronted with a granite-looking rock that defies orthodox pigeon-holing? What's his next step? And how does he go about prevailing upon these categorically right-minded individuals to come scurrying to his aid? And then what does he do after the consultation of doctors has taken place, and the smoke of intellectual battle has finally cleared? Chances are that he'll still have to weigh the evidence and figure out the answer himself. In his fundamental training, however, he should be provided with a broad enough viewpoint to realize that the theory of metasomatic feldspathization on a large scale is rational and well founded, and is valuable heritage from deservedly renowned scientists. In spite of his implied fear that too many geologists will overstep the bounds of conventional geologic propriety, Professor Grout does indeed present students with a broad-minded concept, for in his valuable and comprehensive text on petrology[21] he makes the following statement: "If a granite magma is introduced into massive quartzites and so disseminated that its channels of access are not visible, it may so largely replace the original as to form a rock indistinguishable from granite. Some intermediate stages in this series of replacement effects suggest that certain large masses of granite may be really results of replacement." He seems just a bit overcautious and discouraging in his 1941 paper, but he has a righteous quarrel with vague terminology.

A review of the literature leads to the view that most complete granitization takes place in rocks of highly siliceous character, particularly the impure quartzites. This suggests that comparatively little quartz is added in the process; some of it appears as myrmikitic replacement of feldspar. It would seem, too, that some alumina may be added as aluminous silicates, for the alumina content of many impure quartzites is rarely high enough, by several per cent, to equal the requirements of a granitic composition. Potash and soda are introduced, but some of the potash is derived from the sediment itself. Some titanium becomes fixed as titanite.

Highly calcareous beds may develop a labradorite or bytownite and pyribole-zoisite facies under equivalent conditions, that is clearly suggestive of a contact-metamorphic origin, but may not be closer to a contact zone with truly igneous material than other parts of the granitized facies. The term "regional contact metamorphism" has been applied by some geologists to the regional metamorphism by igneous agencies acting over a large area, including facies that are granitized products.

Fine-grained argillites, such as phyllites, are relatively compact, and though they are susceptible chemically they are not permeated so easily as are the coarser-grained sediments. Their incompetency promotes squeezing and flowage rather than the development of shatter fractures and porosity, and the metamorphic minerals in them may be more completely derived from the inherent rock constituents under increased thermal gradient than is true of the more competent formations. Even the phyllites, however, show the penetrative effects of hydrothermal solutions. For example, a low-to-medium-grade phyllite in eastern Vermont showed saddle-shaped replacement grains of feldspar on the crests

[21] GROUT, F. F., *Petrography and petrology, a textbook.* New York, 1932.

of minute crinkles. These feldspar grains are neither fractured nor distorted, and they penetrate the rock folia on both limbs of the minute folds; trains of tourmaline crystals occupy the fracture cleavages in the axial planes. Small lenses and veins of hydrothermal quartz are abundant in the formation.

Igneous rocks also are susceptible, but like sedimentary rocks the original composition influences the completeness of "granitization." Gilluly described an outstanding example,[22] in which a quartz diorite was changed to albite granite. He gives a summary of the microscopic evidence that suggests replacement; similar mineralogic and textural features are duplicated in the Chelmsford granite, and other replacement granites derived from siliceous sediments.

Replacement granites commonly have a pseudoporphyritic texture. Porphyroblasts of oligoclase or albite-oligoclase are commonly formed as metasomes during the first wave of invasion. These are succeeded by the development of potash feldspar in the groundmass, and these in turn by albite and myrmikitic quartz. The textures are predominantly metasomatic.

In the New England area such metasomatic phenomena range from incipient feldspathization of low-grade rocks to what appears to be one of the most striking examples of replacement granite on record, that in the Westford-Chelmsford area, Massachusetts. Broad, roughly parallel zones both of metamorphic grades and of hydrothermal invasion are suggested by the areal distribution of facies. I shall outline briefly my concept of these zones. It is to be emphasized, however, that they cannot be sharply delineated or separated completely from one another. A great deal more detailed mapping is needed to demonstrate the gradations and complexities, but it already seems clear that the grade zones of metamorphism are not susceptible to separation by boundaries as simple as might be expected of a sequence determined purely by depth-zone control. Instead of a simple gradational system the zones overlap and intermingle in detail, as indeed one might expect where invasive agencies have been operative and the metamorphism is a function not only of depth but also of belts of deformation and subjacent intrusion.

It is interesting to note that Billings has abandoned, apparently, his earlier method of mapping depth zones according to Grubenmann's classification of epi-, meso-, and katazones, and that he favors simple grade-zone nomenclature for the rocks of New Hampshire. In his paper on the White Mountains area he shows mineralized subzones, and says "The subzones of metamorphism of the Mt. Washington area result from variations in the metamorphic history in different sections. There is no evidence that the subzones were buried at different depths. The temperature, however, may well have been different from place to place"[23] and, "The gneisses of the Mt. Washington area formed by processes identical to those postulated for central Massachusetts by Larsen and Morris (1923). The process is similar to that described by Currier (1937) in the Chelmsford-Westford district of Massachusetts and at Milford, New Hampshire."[24]

Briefly, the picture that seems to be shaping up is as follows. From the Green Mountains axis the metamorphic grade increases in general toward the east and southeast, and three major zones appear.

(*a*) A zone of low-grade metamorphism in central and eastern Vermont and western Massachusetts, in which quartz and quartz-ankerite veins are abundant, and pegmatites are relatively sparse and small.

(*b*) East of the low-grade zone a belt of medium and high-grade metamorphism that swings southwesterly into and across Connecticut, and northeasterly through east-central New Hampshire into Maine. This zone includes the prominent pegmatite belt of New Hampshire, central Massachusetts, and western Maine; it also includes most of the migmatitic domes that are com-

[22] GILLULY, JAMES, *Replacement origin of the albite granite near Sparta, Oregon.* U. S. Geol. Surv. Prof. Paper 175: 65–81. 1933.

[23] BILLINGS, M. P., *Structure and metamorphism in the Mt. Washington area, New Hampshire.* Bull. Geol. Soc. Amer. **52**: 924. 1941.

[24] *Ibid.*, p. 931.

mon in western New Hampshire, and central Massachusetts. In this general zone medium and high-grade facies of metamorphic rocks are complexly related.

(*c*) Generally east and south of zone *b*, a belt that is dominated by relatively coarse-grained granites, gneissic granites, and paragneisses. Most of the known granite stocks and "batholiths" of Maine and Massachusetts, particularly those granites of coarse texture, lie in the coastal part of this belt.

A map of known granite bodies that are clearly intrusive shows that they are distributed widely through all three belts. Granite bodies in the coastal area are predominantly stocklike, and among them are most of the relatively coarse-grained granites, such as those of the Jonesboro, Mt. Desert, Stonington (Deer Isle), Vinalhaven, Biddeford, and Kennebunkport districts in Maine, and the Rockport, Peabody, and Quincy districts of Massachusetts. The finer-grained granites are more common farther inland, and, except for a few occurrences, as at Redstone, New Hampshire, the granites of this area are fine to medium grained and occur predominantly as sills, dikes, and small stocklike masses; examples of these granites are to be seen in the Fitzwilliam, Troy, Milford, and Concord districts of New Hampshire, and the Acton, Carlisle, and Fitchburg districts of Massachusetts. Note that from this catalog are excluded the markedly gneissic granites whose origins and forms are not certain, or that show strong evidences of migmatitization. In central and eastern Vermont also are many granite intrusives which, for the most part, are relatively small bodies and whose textures are fine to medium grained. Examples of these granites are those known commercially as the Barre, Bethel and Woodbury granites. It is noteworthy that the intrusives of zones *a* and *b* have had little apparent metamorphic effect upon the enclosing rocks, and that associated pegmatites are comparatively small and few.

The age relations of the metamorphic, invasive, and intrusive phenomena are not completely established. For New Hampshire, Billings interprets at least three ages of intrusive rocks; of these the late Devonian intrusives—his New Hampshire magma series—were associated with a period of major deformation, and he believes that there was no comparable episode of deformation in the Carboniferous period or at the close of the Paleozoic era. In Massachusetts the migmatitic rocks and pegmatites of the medium and high-grade belt were assigned to the Carboniferous by Emerson[25] and others, on the basis of flora from the Worcester phyllite. There seems to be sufficient question, however, about this correlation to warrant a reexamination of the fossils. If the fossils should prove to be assignable to the Devonian, the apparent anomaly of Carboniferous or post-Carboniferous migmatitization in Massachusetts disappears. Also the problem of the apparently anomalous lithology of the Boston and Narragansett Basins—which are underlain by comparatively unmetamorphosed Carboniferous sediments—will also be resolved. The rocks of these basins interrupt the continuity of the coastal belt of highly intruded and metamorphosed rocks.

The Chelmsford granite is believed to represent the metasomatic replacement of schistose quartzitic beds of the Merrimack quartzite, in the belt of gneissic granites and paragneisses. This formation is correlated with the Oakdale quartzite of the Worcester area, a formation below the Worcester phyllite, and separated from the phyllite by the Harvard conglomerate. The strata above and below the Merrimack quartzite are highly invaded by pegmatites and replacement veins. The "Chelmsford granite" is well exposed by quarries and by natural exposures through a belt 15 miles long and up to $2\frac{1}{2}$ miles wide, trending northeasterly across the Lowell, Tyngsboro, Westford, and Ayer quadrangles of northeastern Massachusetts. The best exposures and quarries are in the town of Westford. The outcrop belt conforms perfectly with the general regional trend of the sedimentary formations, that is, N.

[25] EMERSON, B. K., *Geology of Massachusetts and Rhode Island*. U. S. Geol. Surv. Bull. 597. 1917.

40° to 45° E. The northeastern and southwestern limits of the granite have not yet been determined closely, but the mass thins gradually in these directions. The end zones as well as the border zones are indefinite, and are intercalated with the bordering schists in various degrees of migmatitization.

The granite is well "banded." In most places the "bands" or layers (believed to be relicts of original bedding) are distinct, thin, remarkably uniform and persistent; in some places the layers are less distinct but still definite, and in still other places, notably on the crests and troughs of folds, the layers are vague or even wanting. Several folds can be traced within the granite, and a schistosity superimposed on the "bedding" is parallel with the axial planes, and so cuts across the layers at a very sharp angle. These features are exposed well in the larger quarries of the district in one of which several folds have been traced and mapped. The remarkable uniformity and persistence of the layers, the folding, and the parallelism of the superposed schistosity with the axial planes are considered to be strong evidence of the derivation of this granite from a sedimentary schist. Such structures could not result from either plastic or liquid flow.

Schist and quartzite inclusions in the granite, to be seen in several of the quarries, are oriented parallel with the layering and in accord with the regional structure. Most of the inclusions are of biotite schist, representing a reconstitution of the original rock, and range from elongated masses with metasomes and thin irregular layers of feldspar to mere shreds of biotite that gradually fade out along the strike into the granitic rock. A few of the inclusions are of relatively dense and pure quartzite; they have irregular but comparatively sharp contacts with the granite.

The granite is cut by countless thin pegmatite veins, rarely more than a foot thick, and mostly but a few inches thick. Commonly these veins cross the layers at a large angle; their comblike crystals of feldspar and muscovite, however, are continuous with the foliation of the host rock and are therefore not perpendicular to the walls of the veins. The contacts are irregular and vague. Pegmatite veinlets of a later generation are also present; they have sharp contacts and in places contain abundant black tourmaline.

It is not my purpose at this time to present the details of evidence for a metasomatic origin of the granite. Such is planned for a later and more specific paper. But the mineralogic features, textures, and structures that characterize the Chelmsford granite are to be found in all degrees of development throughout the metamorphic zones of New England, and it seems necessary to consider the so-called "granitization" as a regional metamorphic process—a gradational phenomenon that has left its impress upon rocks of all grades, and whose manifestations range from incipiency to dominancy in the reconstitution and recrystallization of the rocks, regionally as well as locally. The theory of granitization cannot be looked upon as a fad. It is a basic concept, and must be a common and legitimate recourse for the metamorphic geologist.

BOTANY.—A new species of *Elsinoë* on capulín cherry (*Prunus capuli*).[1] ANNA E. JENKINS, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering.

On January 4, 1940, a leaf spot caused by *Elsinoë* (*4*) was discovered on capulín cherry (*Prunus capuli* Cav.) growing in the nursery at the Estación Experimental Central, Ministerio de Agricultura y Cria, at Caracas, Venezuela, by M. F. Barrus, of Cornell University, then on sabbatical leave in Venezuela, and by A. S. Muller, then plant pathologist at the Station. Specimens were transmitted to the writer with the

[1] Received December 6, 1946.

statement that the diseased tree had recently been introduced from Mexico. It is possible that the tree was already infected in Mexico, where the capulín is said to have originated (cf. *6*, note by S. F. Blake, p. 58, and *8*).

The lesions produced by the *Elsinoë* were large and conspicuous and ascomata were prominent on them. The conidial stage was rare on the specimen collected in January but was abundant on a specimen from the same source, collected on March 1, 1941, by Dr. Muller. In this case the perfect stage was not seen. The fungus appears to be new and is described as follows:

Elsinoë pruni, n. sp. (Fig. 1)

Leaf spots conspicuous, few to numerous, as many as 50 on a leaf, scattered, sometimes marginal, circular to subcircular, minute to 5 mm in diameter, coalescent, usually in small groups, up to 5 mm in diam., above, "vinaceous-buff"[2] to gray, including "pale mouse gray," or whitish, sometimes shading to brown including "deep vinaceous-brown," margin slightly raised, even to finely undulate, brown to purple, including "Mars violet," below brown often shading to purple, including "dull dark purple," fructifications of the fungus appearing as dark pustules on the spots; ascomata numerous, up to 60 on an individual spot, pulvinate, with rounded margin, black, up to 200μ or more in diam., by 60–80μ in thickness, arising intraepidermally, then becoming erumpent, covered with a dark epithecium reaching 15μ in thickness, sometimes coalescent; asci numerous, subglobose to broadly ovoid or pyriform, 22–30 by 16–22μ; ascospores fusiform-elliptical, straight or slightly curved, becoming 3-septate, slightly constricted at the median septum, hyaline, 14–18 by 6–8μ.

Imperfect stage, *Sphaceloma pruni*, n. sp.

Fructifications conspicuously rupturing the epidermis, becoming erumpent-superficial, circular to irregular, or elongate, reaching 500μ in length by 200μ in width, coalescent or branching, olivaceous to nearly black, at first in the form of an acervulus, then sometimes becoming sporodochial, often about 50μ in thickness, the palisade of colored conidiophores usually at least 14μ thick, individual conidiophores 3–5μ in diam., often pointed at the tip, sometimes elongating, hypha-like from conidia remaining in situ, or otherwise, continuous or septate, occasionally geniculate; conidia minute, spherical, hyaline, to narrowly ovoid or fusiform-elliptical, dusky, up to 15 by 2.6–5μ.

Maculae in foliis, superne conspicuores, paucae usque numerosae, conspersae vel marginales, circulares vel subcirculares, aliquando paucae coalescentes, usque 5 mm in diam., supra vinaceo-bubalinae usque grisae vel albidae interdum brunnescentes, margine subelevato, integro ad subleniter undulato, brunneo-purpurascenti, inferne brunneo-purpurascenti, ascomata numerosa, pulvinata, atra, usque 200μ in diam. et 60–80μ crassa; epithecium usque 15μ crassus; asci in massis pseudoparenchymoides numerosi, subglobosi ad late ovoidei vel pyriformes, 22–30 by 16–20μ; ascosporae fusiform-ellipticae, hyalinae, 3-septatae et septum medium paulo constructae, 14–18 $\times$ 6–8μ.

Status conidicus, *Sphaceloma pruni*, n. sp.

Fructificationes conspicue epidermidem perfringentes, erumpentes et superficiales, circulares ad irregulares vel elongatae, usque 500 $\times$ 200μ, olivaceae ad atrae, in forma acervuli vel sporodochii, saepe ca. 50μ in diam.; pali conidiophorum obscuri, ad minimum 14μ crassi; conidiophora 3–5μ in diam., interdum supra palos se protrahendentia, hyphoidea; conidia minuta, sphaeroidea, ad angusta ovoidea vel fusiform-elliptica, fusca, usque 15–2.6–5μ.[3]

Distribution.—Producing the disease "anthracnose of capulín cherry" (*Prunus capuli* Cav.) (Rosaceae) in Venezuela, South America.

Specimens examined.[4]—PERFECT STAGE: On leaves of *Prunus capuli*, Caracus, Sta. Federal, Venezuela, January 4, 1940, M. F. Barrus and A. S. Muller (HV 3763, IB 4193, CU 31760,

[2] Colors in quotation marks are based on Ridgway (*7*).

[3] Translation into Latin by Miss Edith K. Cash.

[4] Symbols indicating the herbaria in which these specimens are deposited are as follows:

HV	Herb. Micol. Exp. Central., Min. Agr. e Cria, Caraças, Venezuela
IB	Secc. Fitopat., Inst. Biol., São Paulo, Brazil
CU	Cornell Univ. Plant Path. Herb., Ithaca, N. Y.
USM	Mycol. Coll., Bur. Plant Indus., Soils, and Agr. Engineering, U. S. Dept. Agr., Plant Industry Station, Beltsville, Md.

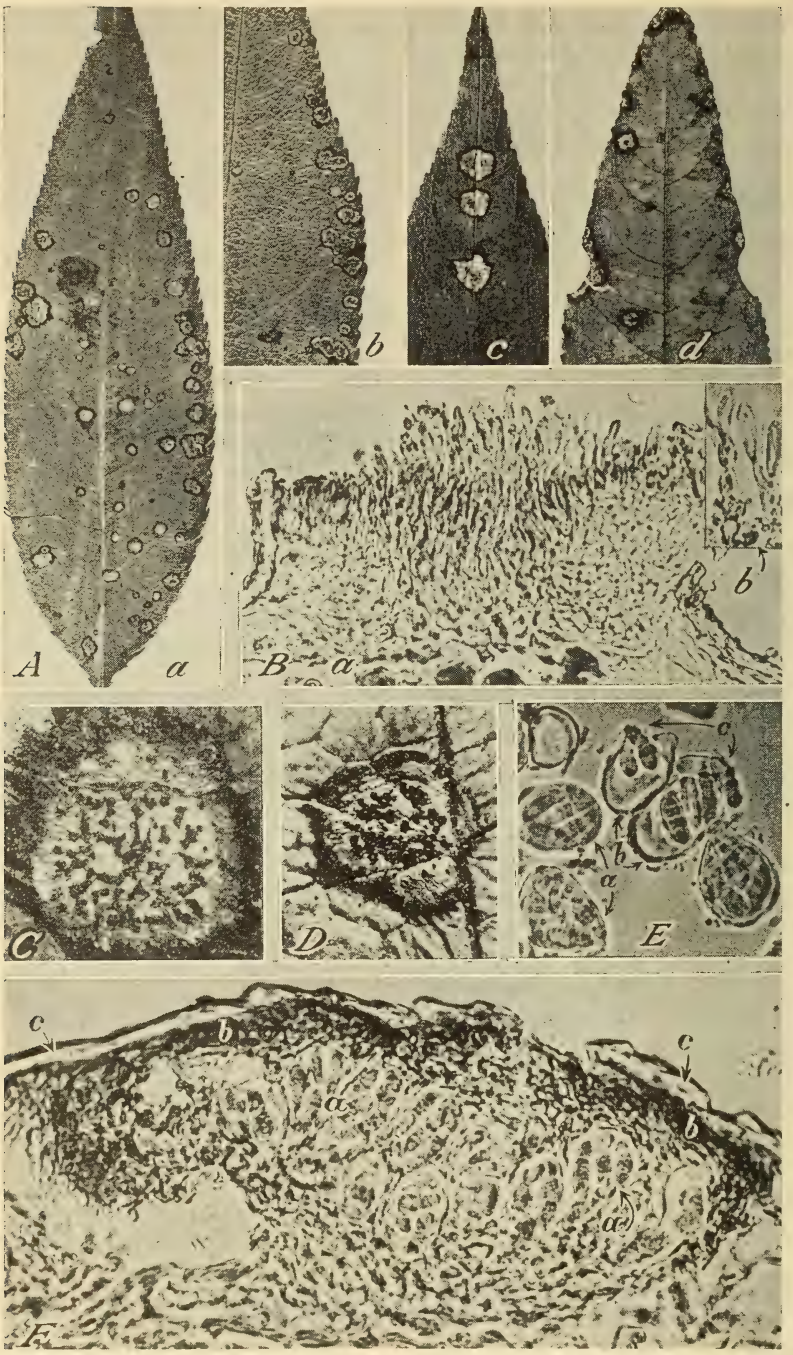


FIG. 1.—*A*, Leaf spot caused by *Elsinoë pruni* on capulín cherry from Caracas, Venezuela, *a* and *b*, collected on March 1, 1941, by A. S. Muller; *c* and *d*, on January 4, 1940, by M. F. Barrus and A. S. Muller; all ×1. *B*, *C*, Conidial stage (*Sphaceloma*) on specimen collected in March, *C*, abundant fructifications on light-colored central area of an individual spot (×13), *B*, *a*, acervulus in section and *B*, *b*, individual conidiophores and conidia from another section (×500). *D–F*, Perfect stage on specimen collected in January, *D*, individual leaf spot with ascomata showing as dark-colored pustules on the central area (×7), *E*, asci (*a*, *b*), containing ascospores (*c*) (×500), *F*, an ascoma with numerous asci (*a*), *b*, darkened peripheral region, *c*, outer wall of ruptured epidermis (×500). Photographs by M. L. F. Foubert.

USM 73419 Type); June 16, 1940, A. S. Muller (HV 3904, IB 4107, CU 31761, USM 74118).

IMPERFECT STAGE: On leaves of *Prunus capuli* Cav., Caracas, Sta. Caracas, Sta. Federal, Venezuela, March 1, 1941, A. S. Muller (IB 4194, USM 73780 Type).

Note.—Relative to *Sphaceloma* on other species of *Prunus* than *P. capuli*, it has previously been inferred (*2*, p. 263) that Garbowski's (*1*) report of *Hadrotrichum populi* Sacc. on plum (*P. domestica* L.) from the peninsula Crimea (south Russia) concerns a *Sphaceloma* on that host. (*H. populi* is, of course, the *Sphaceloma* of poplar (*Populus*), now known as *S. populi* (Sacc.) Jenkins (*2*, p. 264). Unfortunately, a specimen of the so-called *Hadrotrichum* on plum is not available as Garbowski informed the writer in 1930. In the abstract reporting the *Sphaceloma* on capulín cherry (*3*), reference is made to *Sphaceloma* on chokecherry (*P. virginiana* L.) It is here explained that the lesions on the chokecherry leaves strongly suggested the presence of *Sphaceloma*, but absolute evidence of the existence of the fungus on them has not been obtained. Until further data are available, therefore, this record should be regarded as provisional. Similarly, lesions from their appearance attributable to *Sphaceloma* (or *Elsinoë*) are present on a certain specimen of hollyleaf cherry (*P. ilicifolia* (Nutt.) Walp.) and of Catalina cherry (*P. lyonii* (Eastw.) Sarg.) from California (*5*).

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ENTOMOLOGY.—*A new species of* Culex *from New Guinea (Diptera, Culicidae).*[1]

ALAN STONE, U. S. Bureau of Entomology and Plant Quarantine, and GEORGE HENRY PENN, Cornell University.

For some time the writers have had before them a *Culex* quite different in coloration from any previously described except *C. binigrolineatus* Knight and Rozeboom,[2] and differing from that species in the male genitalia, the larva, and the pupa. Like *binigrolineatus*, the larva of this species is found in the leaf axils of the sago palm (as well as other plants), and the females of the two species are scarcely distinguishable. Because it is desired to refer to this species in other papers on the mosquito fauna of New Guinea, it is being described at this time.

[1] Received December 2, 1946.

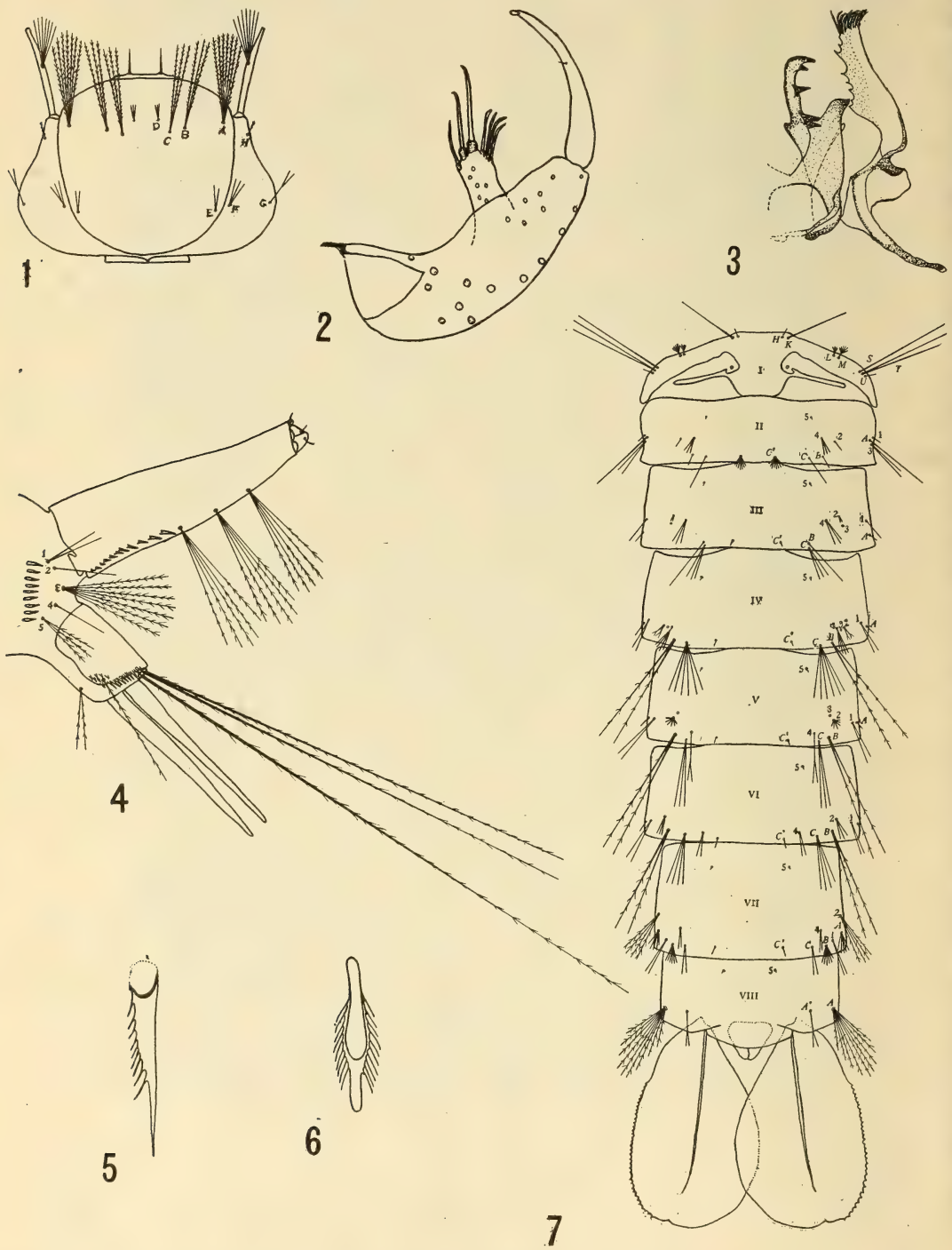
[2] Proc. Ent. Soc. Washington **47** (9): 289–295. 1945.

Culex bicki, n. sp.

FEMALE: Rather small, the wing length 3 mm. Scales of head and scutum predominately white, the mesoscutum with a pair of dark stripes converging posteriorly. Scarcely distinguishable from *binigrolineatus* Knight and Rozeboom, the only observed difference being that the bare portions of the dark mesoscutal stripes are less apparent, the dark bronzy-brown scales being more evident.

MALE: Coloration as in female. Long ventral hairs of proboscis not forming a tuft before middle, as in *binigrolineatus*, but scattered on apical half. Antenna scarcely shorter than proboscis, and palpus longer than proboscis by no more than half of the fifth segment. Otherwise as in *binigrolineatus* externally. *Genitalia* (Figs.

2, 3). Basistyle conical, without scales, but with a number of long hairs on lateral and dorsal surfaces. Subapical lobe rather large, with two stout filaments and about five smaller setae. Dististyle slender, tapering, a minute seta beyond middle, the terminal spine very short,



FIGS. 1–7.—*Culex bicki*, n. sp.: 1, Head of larva; 2, basistyle and dististyle of male genitalia; 3, lateral plate of mesosome and tenth sternite; 4, apex of abdomen of larva; 5, pecten tooth; 6, comb scale; 7, abdomen of pupa.

broad. Lateral plates of mesosome with five (rarely more) stout teeth on upper arm, two apical, two basal, and one median (the holotype has three teeth in the apical group of one of the arms); lower arm projecting obliquely with the apex truncate. Inner edge of tenth sternite with a row of irregular denticles, the apex with a number of slender, curved spines; basal arm short, stout, curved. Ninth tergite simple, without lobes, evenly clothed with long hairs.

LARVA: *Head* (Fig. 1). Shape and color as in *binigrolineatus*, differing only in the following characters: Antennal tuft consisting of 7 to 10 long, nonplumose hairs, situated between 0.6 and 0.7 length of segment from base; anteantennal tuft (A) finely plumose, 5- to 8-branched, usually 7; lower and upper head hairs (B and C) finely plumose, 2- to 4-branched, usually 3; posterior clypeal tuft (D) short, 2- to 3-branched, usually 3; inner occipital hair (E) 2-branched; outer occipital hair (F) 3- to 4-branched, usually 3; orbital hair (G) single or forked beyond middle; and, subantennal hair (H) inconspicuous, usually single.

Abdomen (Figs. 4, 5, 6). Similar to that of *binigrolineatus*, differing chiefly in having the comb teeth of segment VIII in a straight line, consisting of 8 to 11 teeth, usually 9; teeth each with a central blunt spine fringed on either side by 9 or 10 fine, short hairs. Pentad hairs of VIII: 1 usually 2-branched, range from 1 to 3; 2 and 4 always single; 3 finely plumose, 6- to 10-branched, usually 7; 5 finely plumose, 2- to 4-branched, usually 3. Siphon like that of *binigrolineatus* in shape and color, pecten averaging 11 teeth with a range of 10 to 14; 3 pairs of siphonal tufts, 3- to 6-branched, usually 5, finely plumose apically. Anal segment as in *binigrolineatus* except ventral brush which usually consists of a pair of bifid, finely plumose hairs.

PUPA: *Cephalothorax*. Shape and pigmentation as in *binigrolineatus*. Hair 2 prominent, 3- to 4-branched, slightly plumose; hair 10 usually 3-branched; 11 single, prominent; 12 usually 3-branched.

Abdomen (Fig. 7). Segments II and VIII well pigmented as well as the "bridge" between the float hairs on segment I. Differs conspicuously from *binigrolineatus* in that only the larger posterolateral hairs of abdominal segments IV-VIII are finely plumose, all others being nonplumose. All hairs of segment I nonplumose, H, S, and T being the strongest developed; segments II and III without any conspicuously well-developed hairs; segments IV-VI with hair B large, 2-branched and finely plumose, and C large, multibranched and nonplumose; segment VII with hair 2 most prominent, 4-branched, and finely plumose; segment VIII with hair A 9-branched and finely plumose. Paddles without apical hairs, but lateral margin finely serrate and tip slightly notched beyond midrib; midrib weak not reaching hind margin of paddle, which is very thin apically and often difficult to discern without special lighting; paddle sometimes with an irregular line of black pigment near base.

MATERIAL STUDIED: *Holotype:* Male, reared from larva in sago axil, Toem, Dutch New Guinea, VII-17-1944, Edward S. Ross. *Paratypes:* Same locality and collector: 2♂♂, 2♀♀, same data as holotype; 3♂♂, 2♀♀, from taro, (?) VI-1944, 1♀, 23 larvae, from sago axils, VI-30-1944; 1♀, VII-10-1944. Hilimoi, Milne Bay, Papua, 1♂, 5♀♀, with four associated larval skins and six associated pupal skins, ex *Pandanus* leaf axil, IX-12-1944, George H. Bick (through G. H. Penn, Elizabeth N. Marks, and T. K. Ruebush); Milne Bay, Papua, in thick jungle, 1944, Yves Guillory (through Elizabeth N. Marks). Holotype and paratypes, United States National Museum No. 58245. Other paratypes to be deposited at Cornell University, University of Queensland, California Academy of Sciences, and the British Museum.

We are indebted to the collectors and those who submitted this material to us for the opportunity of describing this interesting species.

TAXONOMIC POSITION: The assignment of this species to any of the described subgenera is difficult. Knight and Roseboom tentatively placed the closely related *binigrolineatus* in the subgenus *Neoculex*, although admitting that the only reason for not treating it as a *Culiciomyia* was the absence of modified bristles on the male palpus. There are, however, translucent bristles on the ventral surface of the palpus that are not so modified as in *Culiciomyia* species. These two species, *binigrolineatus* and *bicki*, along with two undescribed species from the Solomon Islands, form a rather distinct species group that will probably warrant the erection of a new subgenus.

ENTOMOLOGY.—*A new genus of flea beetles from the West Indies.*[1] DORIS H. BLAKE, Arlington, Va.

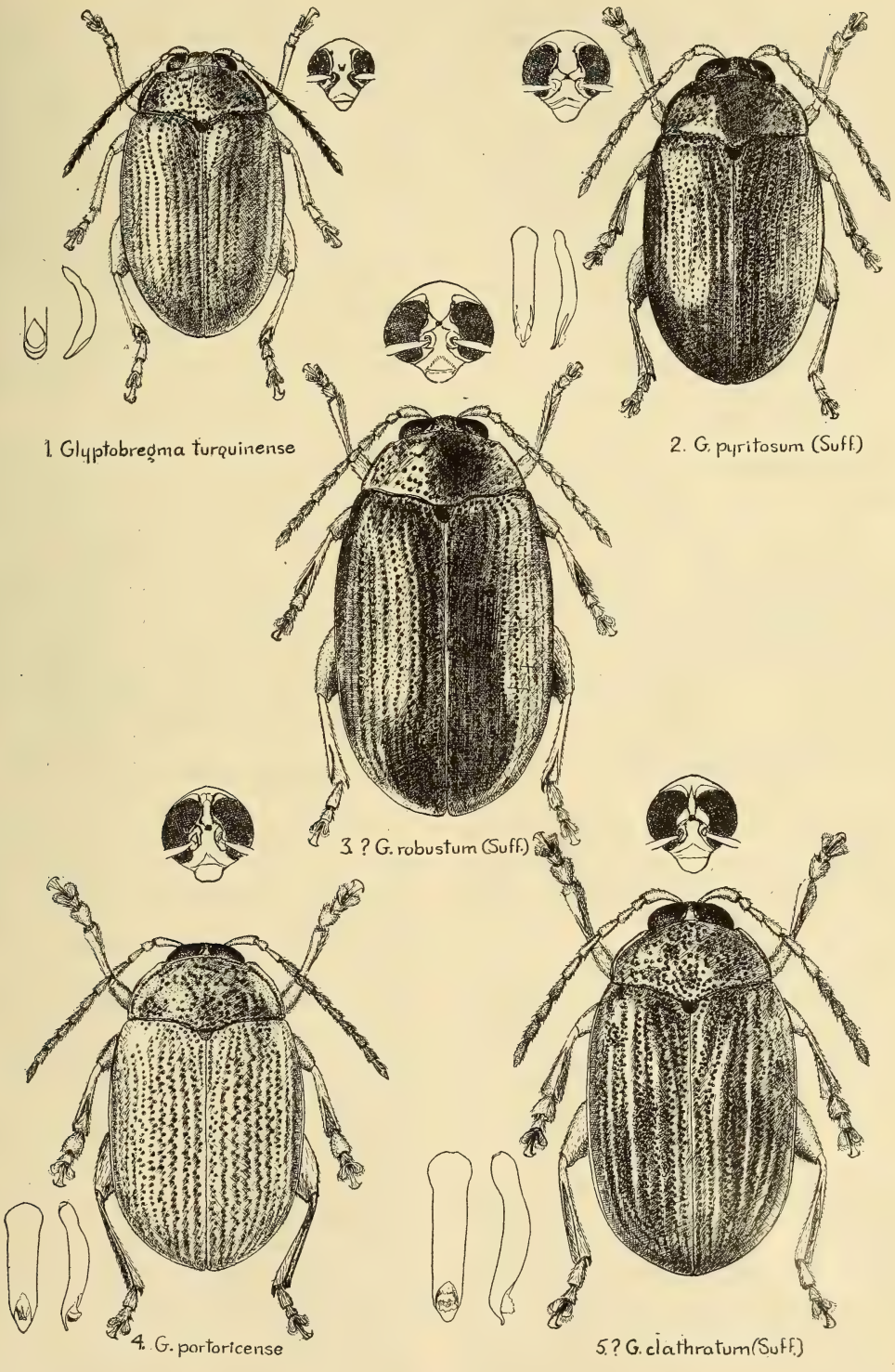
Two new species of a genus of flea beetles that has hitherto gone without a name have recently been collected, one from the region of the Pico Turquino, in Oriente Province, Cuba, the second, the only one of its group from outside of Cuba, from Puerto Rico.

In his treatment of the Cuban Chrysomelidae, Suffrian[2] grouped under *Haltica* such related genera as "*Graptodera, Crepidodera, Phyllotreta,* and *Aphthona*" and others. Frequently, under a section head designated merely by a letter, he described, without giving a name to it, a group that did not belong under any of the genera known to him. Such a group is that characterized in a brief Latin description under section *c* (p. 187) of his treatment of *Haltica.* Following this short generic description he described four species, *H. interstitialis, clathrata, pyritosa,* and *robusta.* Of *H. interstitialis* he remarked that in habit and color it reminded him of a species of *Helophorus,* a water beetle, belonging to a wholly unrelated group. He also compared it with species of *Phratora* (*Phytodecta*) but stated that it definitely did not belong to that genus, being a halticid. In Gemminger and Harold's Catalogue (vol. 12, 1876, pp. 3496–3497) these four species were placed under *Disonycha.* Heikertinger in the Junk Catalogue followed Harold's arrangement, leaving them still in that genus. Except for their broadly oblong oval shape and the short legs with the small spur at the end of the tibiae, there is not much resemblance to *Disonycha.* In fact, they are not very closely related to any halticid with which I am familiar. Their short broad thorax and large eyes suggest some species of *Dibolia* or *Megistops,* but they lack the large double spur at the end of the hind tibia. They have three outstanding characteristics that separate them from any related genera—(1) the peculiar carving of the head, consisting of a deep groove on either side along the margin of the eye, (2) the lobing at the middle of the base of the thorax, and (3) the deep, striate, often partially geminate, punctation of the elytra, which tends to produce interstitial costae. This combination of characters makes these six species unique enough to deserve generic separation. The name **Glyptobregma** is proposed for the group. (γλυπτός carved, βρέγμα forehead). *Glyptobregma portoricensis* is selected as the type of the genus.

Of Suffrian's species I can identify only *H. pyritosa* with complete assurance. The late Dr. E. A. Schwarz identified a series of specimens that he collected at Cayamas, Cuba, as *H. interstitialis.* Suffrian differentiated *interstitialis* and *clathrata* by the difference in development of the elytral costae, which in *interstitialis* were uniform and in *clathrata* (Fig. 5) unequally developed (the 2nd, 4th, and 6th being stronger than the others). In Schwarz's series, which seems to be clearly one species, both forms are found. I have separated them in the key on the basis of Suffrian's description, being unwilling to unite them without some knowledge of the types. I have only two females from Las Animas, Sierra Rangel, that I refer with some doubt to *robusta* (Fig. 3). Suffrian described the species as steely blue with the breast and outside of the legs bluish. These have a bluish luster and are reddish brown beneath without any blue, and they are slightly larger than Suffrian's measurements. Specimens from Cayamas, Santa Clara Province, Cuba, identified as *pyritosa* by Schwarz, agree with Suffrian's description of that species.

Description of the genus.—3–5 mm in length, oblong oval, not very convex. Head with large and in some species very closely placed eyes, a small pit between the frontal tubercles, and on either side a deep furrow extending along the inner margin and in some species around the eye. Antennae not reaching the middle of the elytra, the basal joint long and curved. Thorax, short and greatly broadened behind with the basal margin lobed over the scutellum; coarsely and deeply punctate, the punctures occurring in groups or irregular rows and produc-

[1] Received December 20, 1946.
[2] Arch. für Naturg. **34** (pt. 1): 176. 1868.



FIGS. 1–5.—*Glyptobregma*, n. gen.: 1, *G. turquinense*, n. sp.; 2, *G. pyritosum* (Suffrian); 3, *? G. robustum* (Suffrian); 4, *G. portoricense*, n. sp.; 5, *? G. clathratum* (Suffrian).

ing a rugosity of the surface. Scutellum somewhat sunken. Elytra not much wider than the thorax, rather flat, and with 10 rows of coarse, deep, and sometimes partially geminate punctation, in some species forming weak costae between the striations. Epipleura extending only to apical narrowing. Body beneath with open anterior coxal cavities. Hind femora thickened, hind tibiae and usually middle tibiae sulcate to some extent, a short spur at the end of the hind tibiae. Claws broadly dentate at base.

KEY TO THE SPECIES

1. Yellowish or reddish brown in coloration....2
   Blue or black with luster.....5
2. Elytra costate or tending to be costate.....3
   Elytra not at all costate, (Pico Turquino).....*turquinense*, n. sp.
3. Elytra with 9 slightly raised interstitial costae .....*interstitiale* (Suffrian)
   Elytra without 9 regular costae.....4
4. Elytra only indistinctly and irregular costate (Puerto Rico).....*portoricense*, n. sp.
   Elytra with straight interstices (2, 4, 6) more distinctly costate.....*clathratum* (Suffrian)
5. Piceous with a brassy luster.....*pyritosum* (Suffrian)
   Steel blue.....*robustum* (Suffrian)

Glyptobregma turquinense, n. sp.

FIG. 1

About 3 mm in length, oval, deep reddish brown, shining, thorax coarsely and irregularly punctate, elytra with 10 striae of rather coarse punctures, not geminate and the interstices not costate.

Head with the interocular space nearly half the width of head, eyes large but not distinctly emarginate near the antennal sockets, a deep groove above antennal sockets and a depression in the middle between the tubercles, the groove extending up on each side of the front along the margin of the eyes. Antennae not reaching the middle of the elytra, the four basal joints a little lighter in color than the remainder, the first joint very long and curved, third not much longer than second, fourth not quite so long as fifth. Prothorax about twice as wide as long at the base, but anteriorly much narrowed, basal margin lobed above the scutellum; disc coarsely and irregularly punctate, the punctures being grouped more densely on the sides and forming thereby a more depressed area on either side near the basal margin. Elytra without any costation between the 10 rows of striate punctures, the punctures showing almost no trace of gemination, and becoming finer in the apical half; humeri well marked, a distinct depression behind the callosity near the scutellum. Body beneath shining, deep brown; tibiae of hind legs alone showing near the apex a slight sulcation, this not apparent beyond the apical enlargement; a spur at the end of the hind tibia. Claws broadly dentate at base. Length 2.9 mm; width 1.6 mm.

Type.—male, M.C.Z. No. 27663.

Type locality.—"Coast up to Pico Turquino, 3700 ft.," Province of Oriente, Cuba, collected June 10–29, 1936, by J. Acuña.

Remarks.—This species is unlike the rest in not having a long sulcus in the tibiae; in fact, there is only a trace of channeling near the apex of the hind tibiae. The eyes are more distinctly separated than in the other species, and the aedeagus has a broadly rounded tip in contrast to the acutely tipped aedeagi of the others. But in the grooving of the head, the irregularly punctate thorax, and striately punctate elytra, as well as the general shape and coloration this species closely resembles the others.

Glyptobregma portoricense, n. sp.

FIG. 4

About 3–4 mm in length, oblong oval, pale yellow-brown, the elytra tending to be a little darker, faintly shining, eyes very large, thorax irregularly and coarsely punctate, elytra semicostate between the partly geminate rows of punctures.

Head with enormous eyes nearly meeting at the vertex, and emarginate about antennal sockets; a distinctly produced carina between antennal sockets, and a pit between the frontal tubercles, and above them a deep-cut groove on each side extending up and around the margin of the eyes. Antennae reddish brown and not reaching the middle of the elytra, a long curved basal joint, third joint shorter than fourth. Prothorax almost twice as broad as long at the base, narrowed anteriorly and with a lobe on the basal margin above the scutellum; surface coarsely and deeply punctured, the punctures tending to be grouped or in irregular rows with finer surface punctures between. Elytra rather flat with smooth shining humeri and 10 rows of partially geminate, coarse, deep punctures,

producing an irregular costate appearance, more regular and marked at the apex; a few fine shallow punctures apparent on the sides. Body beneath shining reddish or yellowish brown, finely pubescent. Anterior coxal cavities open. Hind femora thickened, tibiae of all legs shallowly furrowed, hind tibiae with a short spur at the end, claws broadly dentate. Length 3–4.4 mm; width 1.7–2.5 mm.

Type male and 36 paratypes (2, in M.C.Z.), U.S.N.M. No. 58259.

Type locality.—Ponce, Puerto Rico, collected December 30, 1932, on *Quercus thompsoni* by R. G. Oakley.

Other localities.—Bayamon, P.R., July 14, 1934, on *Jasminum* sp.; Orocovis, P.R., October 25, 1932, on unknown tree, and Orocovis, December 22, 1932, on *Quercus thompsoni;* San Juan, P.R., Ponce, September 21, 1933, on leaves of *Tabebuia* sp., all collected by R. G. Oakley. Guanica, P.R., collected by C. M. Matos, July 25, 1914 (Stuart Danforth coll.).

Remarks.—This species closely resembles the two Cuban species, *G. interstitiale* and *G. clathratum* (Suffrian), being of the same pale yellow brown coloration and with a broadly oblong oval shape and very large eyes. It differs in its more irregularly and less distinctly costate elytra. The aedeagus has a more tapering tip.

ORNITHOLOGY.—*A report on the birds collected by Logan J. Bennett on Nissan Island and the Admiralty Islands.*[1]

S. DILLON RIPLEY, Yale University. (Communicated by HERBERT FRIEDMANN.)

I. BIRDS FROM NISSAN ISLAND

Dr. Logan J. Bennett during his war service in the U. S. Naval Reserve had occasion to be stationed on Nissan Island, sometimes called Sir Charles Hardy Island, which lies nearly 60 miles east of the southern part of New Ireland in the Bismarck Archipelago. Forty-three specimens were collected in August, October, and November of 1944. Only two previous collections have been made on this Island; by Eichhorn, recorded by Hartert (*On the birds of Feni and Nissan Islands, east of New Ireland,* Nov. Zool. **33**: 33–48. 1926), and by the Whitney Expedition. Hartert noted the fact that the avifauna of Nissan is more closely related to the Solomon Islands than to the Bismarck Archipelago. In only four of the subspecific forms of the immediate area is Nissan populated by a Bismarck rather than a Solomon Island form. For that reason the island is usually classified zoogeographically as one of the northern Solomon Islands. It is also listed politically as part of the northern Solomons by the Australian Mandate Administration.

I wish to express my gratitude to the authorities of the United States National Museum, who have allowed me to examine these specimens, as well as to the Bird Department of the American Museum of Natural History, which has kindly allowed me to use comparative material from the Whitney and Rothschild Collections.

In the following discussion all measurements are in millimeters. The wing measurements are obtained by pressing the wing flat against the ruler. The culmen measurements are of the full length of the exposed culmen.

1. **Demigretta sacra sacra** (Gmelin)

Ardea sacra Gmelin, Syst. Nat. **1**, pt. 2: 640. 1789 (Tahiti).

An adult male in dark plumage was taken on November 2. This species had not been previously recorded from Nissan by Hartert (*l.c.*) or by the Whitney Expedition (*vide* Mayr and Amadon, Amer. Mus. Nov., no. 1144. 1941), although it is bound to occur on every reef and atoll in the area. This specimen is completing the molt.

2. **Haliastur indus girrenera** (Vieillot)

Haliaetus girrenera Vieillot, Gal. Ois. **1**: 31, pl. 10. 1822. ("India"; restricted to new South Wales).

An adult male in worn plumage was collected on October 28.

3. **Haliaeetus leucogaster** (Gmelin)

Falco leucogaster Gmelin, Syst. Nat. **1**, pt. 1: 257 1788 (locality unknown; = New South Wales).

A male adult taken on October 30 is the first record for the Solomon Islands and represents

[1] Received November 11, 1946.

an incursion of typical Bismarck Archipelago fauna. The wing measurement is 501 mm. This specimen is molting the tail feathers.

4. **Megapodius freycinet eremita** Hartlaub

Megapodius eremita Hartlaub, Proc. Zool. Soc. London 1867: 830. 1867 (Echiquier Island).

Two males collected on August 20 and November 11 have wing measurements of 216, 221.

5. **Pluvialis dominica fulva** (Gmelin)

Charadrius fulvus Gmelin, Syst. Nat. **1**, pt. 2: 687. 1789 (Tahiti).

Two males and a female were taken in October and November. The males have traces of dark feathers on the belly.

6. **Numenius phaeopus variegatus** (Scopoli)

Tantalus variegatus Scopoli, Del. Flor. et Faun. Insubr., fasc. **2**: 92. 1786 (Luzon).

A male collected in August of this common migrant is a new record for the Island.

7. **Actitis hypoleucos** (Linnaeus)

Tringa Hypoleucos Linnaeus, Syst. Nat., ed. 10, **1**: 149. 1758 (Europe; Sweden).

Two females were shot in August and November.

8. **Heteroscelis incanus brevipes** (Vieillot)

Totanus brevipes Vieillot, Nouv. Dict. Hist. Nat. **6**: 410. 1816 (no locality; Timor).

A female was taken in November.

9. **Arenaria interpres interpres** (Linnaeus)

Tringa interpres Linnaeus, Syst. Nat., ed. 10, **1**: 148. 1758 (Europe; Gotland, Sweden).

Two females in winter plumage were collected in November.

10. **Sterna hirundo longipennis** Nordmann

Sterna longipennis Nordmann, *in* Erman's Verz. Thier. Pflanz.: 17. 1837 (mouth of Kutchni River, Sea of Okhotsk).

A pair were shot in November. Both are in fairly worn eclipse plumage.

11. **Sterna sumatrana sumatrana** Raffles

Sterna Sumatrana Raffles, Trans. Linn. Soc. London **13**, pt. 2: 329. 1822 (Sumatra).

Two males were taken in November. There is no notation as to whether this species breeds on the Island.

12. **Ptilinopus solomonensis neumanni** Hartert

Ptilinopus solomonensis neumanni Hartert, Nov. Zool. **33**: 42. 1926 (Nissan Island).

Two males of this endemic race, taken in August and November, have wing measurements of 128, 129.5. The November bird is molting. This race is readily distinguishable from *solomonensis*, not only by larger size but also by the noticeably paler lilac crown.

13. **Ducula pistrinaria pistrinaria** Bonaparte

Ducula pistrinaria Bonaparte, Consp. Av. **2**: 34. 1855 (St. George, Solomon Islands).

As Hartert noted (*l.c.*, pp. 34–35), there is a tendency for northern Solomon Islands birds to approach *Ducula p. vanwyckii* of New Ireland. In fact, there seems to be a continuous cline in coloration running in a rough arc from Bougainville to the northeast through Nissan, Feni, probably Tanga, Lihir, and the mainland of New Ireland itself. The backs of Solomon Islands birds are gray-green. Two individuals in the Whitney series from Bougainville have a somewhat less grayish, more greenish suffusion in the color of the back. This tendency is more pronounced in Nissan birds, fully half of which in the combined U.S.N.M. and A.M.N.H. series have a distinctly greenish suffusion. Birds from Feni in the American Museum collection carry the greenish still further, although they still show a strong grayish tint. This cline culminates in birds from Lihir Island, which previously has been included in the range of *p. pistrinaria* (*vide* Peters, *Check-list of birds of the world* **3**: 48. 1937). Three specimens in the Whitney collection of the A.M.N.H. have backs so strongly greenish in tone, so lacking in gray, that I believe that the population of this Island should be included in *vanwyckii*. Birds from Feni and Nissan should be maintained in *pistrinaria*, as there is no strong break in the cline of color. However, a somewhat complicating factor is that Nissan birds show a slight size difference compared to the populations from the rest of the Solomons. Their measurements, including three males taken by Bennett in August, are as follows:

	wing	*tail*	*culmen*
Nissan Island	8 ♂♂ 246–257 (250.5)	150–159 (154.7)	25.5–27 (26.2)
Feni Island	7 ♂♂ 238–252.5 (245.5)	149–161 (155.2)	22–24.5 (23.5)
Bougainville and other Solomons	11 ♂♂ 237–253 (243.5)	144–153.5 (149.3)	23–26 (24.1)

The measurements show that Nissan birds, following the trend of small island populations, have longer bills than birds from the larger islands of the Solomons, but that the population from Feni to the north has definitely shorter bills. In this measurement the Feni birds possibly reflect a cline toward the Lihir and New Ireland population, which has short bills (23.5, 24, etc.). I should hazard the theory that Feni birds express not only a cline in color and size but also a swamping effect, and that Nissan has the most isolated population of the entire group. These differences, of course, are microspeciational in the sense that they can only be talked or written about but not described in taxonomic terms.

This species belongs to the *Ducula aenea* assemblage. A speciation study of the whole group would be most interesting.

14. **Macropygia mackinlayi arossi** Tristram

Macropygia arossi Tristram, Ibis, 1879: 443 (Makira Harbor, San Cristobal Island).

A male and female taken in August measure; wing ♂ 139.5, ♀ 144; tail ♂ 159, ♀ 161; culmen ♂ 12.5, ♀ 12.

15. **Caloenas nicobarica nicobarica** (Linnaeus)

Columba nicobarica Linnaeus, Syst. Nat., ed. 10, **1**: 164. 1758 (Nicobar Islands).

Two males were taken in October and November.

16. **Eos cardinalis** (Gray)

Lorius cardinalis Gray, Gen. Birds **3**: app., p. 20. 1849. (Solomon Islands).

A male was collected in August.

17. **Trichoglossus haematodus massena** Bonaparte

Trichoglossus massena Bonaparte, Rev. et Mag. Zool. **6**: 157. 1854 (Polynesian Islands).

Two males and a female were taken in August and October. One August female has almost obsolete blackish bands on the vermilion breast. These birds run large in size as would be expected from a small island population: wing ♂ 141, 144.5, ♀ 137.5.

18. **Collocalia esculenta becki** Mayr

Collocalia esculenta becki Mayr, Amer. Mus. Nov. no. 486: 16. 1931 (Florida Island, Solomon Islands).

Two males were taken in August and November; the former example has more white on the abdomen than the November bird. Mayr (*cit. supra*) writes of Nissan birds that they are similar to typical *becki;* but with more white on the belly and more greenish above. This description fits our two birds. The present examples are somewhat smaller than Mayr's minimal measurements, having wings of 91 and 93 respectively (his smallest wing length being 96).

19. **Halcyon chloris bennetti,** n. subsp.

Characters.—Similar to *Halcyon chloris nusae* Heinroth but differing in having a longer bill, traces of buff on the lower flanks, and in being less blackish on the upper parts, especially on the crown.

From *novaehiberniae* Hartert of New Ireland, this race differs in having a longer bill, by the lack of any pronounced edging to the breast feathers, and in being more greenish, less blackish on the crown and upper parts. The upper wing coverts and axillaries of *bennetti* also are more bluish, less suffused with green.

Compared to *alberti* Rothschild and Hartert, of the northern Solomons, (Bougainville, Fauro, Kolombangara, etc.) this race differs in the size of the bill and in the color of the lower parts, which are more whitish, less buffy, in the paler whitish nuchal collar, and presumably in the more greenish upper parts.

Only two specimens have been available from Nissan Island where this species is recorded for the first time, but in these two birds the tail measurement also is slightly longer than in any other specimens measured of the races enumerated above.

Type.—U.S.N.M. no. 377009, male adult collected on Nissan Island, August 22, 1944, by Logan J. Bennett.

Measurements.—bennetti: Males (2 specimens), wing 107, 109, tail 71.5, 73.5, culmen 49.5, 48. *nusae:* Male, wing 108, tail 69, culmen 46. Female, wing 111.5, tail 69.5, culmen 46. *novaehiberniae:* Male, wing, 104, tail 70, culmen 43. Female, wing 98.5, tail 64, columen 41. *alberti:* Males (4 specimens) 105–109 (106.9), tail 64.5–70 (67.2), culmen 40.5–45 (42.7). Female: wing 105, tail 68, culmen 47.5.

Mayr (Amer. Mus. Nov. no. 828: p. 6. 1936) gives extensive measurements for *alberti,* of which the above are only a small sample. There is considerable variation in size in this subspecies throughout the Solomons as he points out. However, birds from the immediately adjacent

northern Solomons are considerably smaller than these Nissan birds, and in addition males of *alberti* have the underparts bright rufous, to buffy rufous in some cases. These Nissan males are much more reminiscent of the color of Solomon Islands females, a trait that emphasizes the disappearance of the rufous or buffy underparts in the males of the related subspecies in the Bismarck Archipelago.

This new race is named for the collector.

20. **Halcyon saurophaga saurophaga** Gould

Halcyon saurophaga (Gould, Zool. Voy. *Sulphur* **1**: 39, p. 19. 1843 (New Guinea).

Two males, taken in August and November, do not show any of the blackish spots as noted by Hartert (*l.c.*, p. 45) in his series.

21. **Monarcha cinerascens impediens** Hartert

Monarcha cinerascens impediens Hartert, Nov. Zool. **33**: 40. 1926 (Feni Island).

Two females were taken in August and October. They measure; wing 84, 85; tail 73, 73.5; culmen 18, 18.5. These birds seem similar to specimens from nearby Ontong Java, although possibly they are very slightly paler on the lower parts.

22. **Pachycephala pectoralis dahli** Reichenow

Pachycephala melanura dahli Reichenow, Orn. Monatsb., 1897: 178 (Credner Island).

Two males in fresh plumage were collected in August. The wings of these specimens measure 91, 92.

23. **Aplonis feadensis feadensis** (Ramsay)

Calornis feadensis Ramsay, Journ. Linn. Soc. London, Zool., **16**: 129. 1881 (Fead Island, Solomon Group).

A pair of this large-billed form were taken in August and October. Measurements: wing ♂ 123, ♀ 121.5; culmen ♂22, ♀ 23.

24. **Zosterops griseotincta eichhorni** Hartert

Zosterops eichhorni Hartert, Nov. Zool. **33**: 48. 1926 (Nissan Island).

A pair of this little-known form was collected in August.

II. BIRDS FROM THE ADMIRALTY ISLANDS

The Admiralty Islands had been visited by three expeditions prior to World War II, and two papers have appeared devoted to these collections alone (*The birds of the Admiralty Islands, north of New Guinea,* by Rothschild and Hartert, Nov. Zool. **21**. 1914, and *On the birds of the Admiralty Islands,* by Sclater, Proc. Zool. Soc., London, June 1877). The Whitney Expedition for the American Museum of Natural History collected on several of the Islands, but no complete report has as yet been issued on these collections.

Dr. Bennett as well as others in the Naval Service visited and collected on these Islands during the course of the war, and it is to be expected that several papers will eventually appear devoted to the avifauna of this group. Dr. Bennett collected on several of the Islands at different dates during 1945, as follows:

1. Los Negros, an island to the northeast and immediately adjacent to Manus, the principal island of the group This island has never been collected on previously. Specimens were taken during all months from February through July.

2. Manus, the largest and best known from the avifaunal point of view, still has a relatively large area of untrodden high interior. Specimens were taken here in March, April, and May.

3. Pityili, an islet in a small group west of the northern tip of Los Negros. It has presumably never been collected on before. Some specimens were collected here in April and May.

4. Hauwei, another islet just west of Los Negros, has also probably never been collected on before. Specimens were taken here in March.

5. Ponam, the westernmost of the group of islands running along the north coast of Manus, and west of the tip of Los Negros. Specimens were taken on this previously uncollected island in July.

6. Herringan (also called Harengen or Koruniat), another islet in the Los Negros chain. It has presumably never been previously collected on. Specimens were taken in April.

7, 8. Luo and Butyo Islands, visited by the collector in May, not readily identifiable. I presume that Butyo is an abbreviation for Rambutyo and Luo is another spelling for Lou or St. George Island near Rambutyo and to the north. Rambutyo was visited by the Whitney Expedition.

1. **Fregata ariel ariel** (Gray)

Atagen Ariel (Gray), Genera of birds **3**: col. pl. [185]. 1845 (Raine Island).

A subadult male was taken in February on Los Negros. The label has a notation "uncommon."

2. **Demigretta sacra sacra** (Gmelin)

Ardea sacra Gmelin, Syst. Nat. **1**, pt. 2: 640. 1789 (Tahiti).

Two males and a female were collected on Manus and Los Negros. A male and female are in the dark bluish plumage with white throats. The single Manus male is in the white plumage. The female taken in February in molting the primaries. The species is noted as "common."

3. **Dupetor flavicollis gouldi** (Bonaparte)

Ardetta gouldi Bonaparte, Consp. Av. **2**: 132. 1855 (New South Wales).

An adult male and a subadult female from Los Negros agree in measurements with those given by Mayr for Admiralty Islands birds (Amer. Mus. Nov., no. 1294: 5. 1945). The male is molting the head feathers in February.

4. **Anas superciliosa pelewensis** Hartlaub and Finsch

Anas superciliosa var. *pelewensis* Hartlaub and Finsch, Proc. Zool. Soc. London, 1872: 108 (Pelew Islands).

A pair from Los Negros have wing measurements of: ♂ 249, ♀ 228.5, which are slightly larger than any given by Amadon (Amer. Mus. Nov. no. 1237. 1943), in his survey of specimens from the approximate area (Bismarck Archipelago). The species is noted as "fairly common." The species had not been previously recorded from the Admiralties.

5. **Haliastur indus girrenera** (Vieillot)

Haliaetus girrenera Vieillot, Gal. Ois. **1**: 31, pl. 10. 1822 (India; restricted to New South Wales).

A male and a female were collected on Manus and Los Negros.

6. **Accipiter novaehollandiae dampieri** (Gurney)

Urospizias dampieri Gurney, Ibis, 1822: 453 (New Britain).

A male and a female from Los Negros measure: wing ♂ 212, ♀ 245. The birds were collected in March and noted as "common."

7. **Pandion haliaetus melvillensis** Mathews

Pandion haliaetus melvillensis Mathews, Austr. Av. Rec. **1**: 34. 1912 (Melville Island, Northern Territory).

Two females from Manus and Los Negros are in fresh plumage in April and May. They were noted as "common."

8. **Megapodius freycinet eremita** Hartlaub

Megapodius eremita Hartlaub, Proc. Zool. Soc. London, 1867: 830 (Echiquier Island).

Two males from Pityili and Los Negros have wing measurements of 212, 216. The birds were described as "common." The Pityili specimen in its more brownish coloration is reminiscent of *M. f. affinis.*

9. **Rallus philippensis admiralitatis** (Stresemann)

Hypotaenidia philippensis admiralitatis Stresemann, Orn. Monatsb., 1929: 190 (Manns, Admiralty Islands).

A male of this form, which is rare in museum collections, was taken on Pityili in April. The wing measures 141.5. The specimen is in rather worn plumage.

10. **Porphyrio porphyrio ellioti** Salvadori

Porphyrio ellioti Salvadori, Atti Acad. Sci. Torino, 1879: 1168 (Admiralty Islands).

A male, two females, and an immature female were collected on Los Negros. The species was noted as "abundant." The iris of the young bird is noted as "greenish gray." The adults have wing measurements of; ♂ 232, ♀ 216. One female is in extreme wing molt in February and would appear to have been quite flightless.

11. **Pluvialis dominica fulva** (Gmelin)

Charadrius fulvus Gmelin, Syst. Nat. **1**, pt. **2**: 687. 1789 (Tahiti).

A pair were taken on Hauwei. The male shows traces of black feathers on the abdomen.

12. **Numenius phaeopus variegatus** (Scopoli)

Tantalus variegatus Scopoli, Del. Flor. et Faun. Insubr., fasc. **2**: 92. 1786 (Luzón).

A male and two females were taken on Pityili and Los Negros.

13. **Actitis hypoleucos** (Linnaeus)

Tringa Hypoleucos Linnaeus, Syst. Nat., ed. 10, **1**: 149. 1758 (Europe; Sweden).

A female was collected on Los Negros in March.

14. **Heteroscelus incanus brevipes** (Vieillot)

Totanus brevipes Vieillot, Nouv. Dict. Hist. Nat. **6**: 410. 1816 (no locality: Timor).

Two specimens were taken on Los Negros in February and March.

15. **Arenaria interpres interpres** (Linnaeus)

Tringa interpres Linnaeus, Syst. Nat., ed. 10, **1**: 148. 1758 (Europe; Gotland, Sweden).

A female in winter plumage was secured on Hauwei.

16. **Sterna hirundo longipennis** Nordmann

Sterna longipennis Nordmann, *in* Erman's Verz. Thier. Pflanz.: 17. 1835 (mouth of Kutchui River, sea of Okhotsk).

Two females from Hauwei add this widespread species to the Admiralty Islands fauna.

17. **Sterna sumatrana sumatrana** Raffles

Sterna Sumatrana Raffles, Trans. Linn. Soc. London **13**, pt. 2: 329. 1822 (Sumatra).

A pair taken on Hauwei serves as another addition to the Admiralty Islands fauna.

18. **Thalasseus bergii cristatus** (Stephens)

Sterna cristata Stephens, *in* Shaw's Genl. Zool. **13**, pt. 1: 146. 1826 (China).

Three birds, of which one female is in breeding plumage, were collected on Los Negros and Hauwei in February, March, and June. According to the labels the species is "common."

19. **Anous tenuirostris minutus** Boie

Anous minutus Boie, Isis, 1844, col. 188 (New Holland = Raine Island, Australia).

Two males were collected on Los Negros in February.

20. **Ptilinopus superbus superbus** (Temminck)

Columba Superba Temminck, *in* Knip, Les Pigeons. Les Colombes: 75, pl. 33. 1810 (Halmahera).

Three males and two females were taken on Los Negros in March and May. The species is listed as "rare." A May female is molting the primaries. Wing: ♂ 129, 136, 142; ♀ 135.

21. **Ptilinopus solomonensis johannis** Sclater

Ptilinopus johannis Sclater, Proc. Zool. Soc. London, 1877, 556 (Wild and D'Entrecasteaux Islands, Admiralty Islands).

Three males and two females were collected on Los Negros, Pityili and Ponam. The species was noted as "common" on Los Negros and "rare" on Pityili. Wing measurements of these specimens are: ♂ 118.5, 120, 123; ♀ 115, 119.5.

22. **Ducula pistrinaria rhodinolaema** (Sclater)

Carpophaga rhodinolaema Sclater, Proc. Zool. Soc. London, 1877: 555 (Admiralty Islands).

Two males and a female were taken on Los Negros in March. The species is listed as "common." One male is molting. Wing measurements: ♂ 234, 238.5; ♀ 227.

23. **Chalcophaps stephani stephani** Pucheran

Chalcophaps stephani Pucheran, Voy. Pôle Sud., Zool. **3**: 119; Atlas, pl. 28, fig. 2. 1853 (Triton Bay, New Guinea).

A male from Pityili is described as "rare." The wing measurement is 137.5.

24. **Caloenas nicobarica nicobarica** (Linnaeus)

Columba nicobarica Linnaeus, Syst. Nat., ed. 10, **1**: 164. 1758 (Nicobar Islands).

A male was collected on Los Negros in March. This specimen is molting the head feathers.

25. **Trichoglossus haematodus flavicans** Cabanis and Reichenow

Trichoglossus flavicans Cabanis and Reichenow, Sitzungsber. Ges. Naturf. Freunde Berlin, 1876: 73 (New Hanover).

Two males and three females were taken in April and May on Los Negros, Pityili, and Luo. The male from Luo has a strong reddish-purplish infusion on the feathers of the lower abdomen. Wing measurements of these specimens are: ♂ 152, 154, ♀ 143, 145, 150.

26. **Micropsitta meeki meeki** Rothschild and Hartert

Micropsitta meeki Rothschild and Hartert, Bull. Brit. Orn. Club **33**: 107. 1914 (Manus, Admiralty Islands).

Four males of this interesting species were secured on Los Negros in May. They measure: wing 59.5, 60.5, 61, 61.5; tail 26.5–28.5; culmen (excluding cere) 9–9.5.

27. **Lorius roratus goodsoni** Hartert

Lorius roratus goodsoni Hartert, Nov. Zool. **31**: 123. 1924 (Manus, Admiralty Islands).

Four males and two females from Los Negros in March are recorded as "common." Two males are molting. The series measures: wing ♂ 252, 255, ♀ 231, 238; culmen ♂ 44–45.5, ♀ 39, 40.5.

28. **Ninox meeki** Rothschild and Hartert

Ninox meeki Rothschild and Hartert, Bull. Brit. Orn. Club. **33**: 105. 1914 (Manus, Admiralty Islands).

A pair of this rare owl and an immature male were collected on Los Negros in May and July. The immature specimen (May) is in partially downy plumage, especially on the head, neck, and flanks. The downy plumage is rather pale buffy, ranging to deep tawny on the nape. The wings and tail are colored as in the adult female. In the original description Rothschild and Hartert did not note that the underparts of the adult male tend to be more heavily streaked than in the female. Wing measurements: ♂ 224, ♀ 233.

29. **Collocalia esculenta stresemanni** Rothschild and Hartert

Collocalia esculenta stresemanni Rothschild and Hartert, Nov. Zool. **21**: 293. 1914 (Manus, Admiralty Islands).

A single male from Los Negros was taken June 14. The wing measurement is 95.

30. **Collocalia vanikorensis coultasi** Mayr

Collocalia vanikorensis coultasi Mayr, Amer. Mus. Nov., no. 915: 7. 1937 (Malai Bay, Manus, Admiralty Islands).

One male, taken on Los Negros, March 6, 1945, appears to extend the known range of this swiftlet, previously recorded only from Manus Island. The specimen has been compared with the type and paratypes of *coultasi* by Dr. Mayr, who writes that it agrees with them in every detail.

31. **Collocalia spodiopygia eichhorni** Hartert

Collocalia francina eichhorni Hartert, Nov. Zool. **31** (2): 269. 1924. (St. Matthias Island, nw. of New Hanover.)

One female, taken on Los Negros, February 9, 1945, adds this species to the Admiralty avifauna. This specimen was submitted to Dr. Ernst Mayr, who writes that it is of this species and probably not separable from *eichhorni*.

32. **Hemiprocne mystacea aeroplanes** Stresemann

Hemiprocne mystacea aeroplanes Stresemann, Ann. Orn. Ges. Bayern, no. 5: 38. 1921 (Blanche Bay, New Britain).

Two males and one female were collected on Manus and Los Negros in March and April. The female is molting on the throat. The males have wing measurements of: 225, 227.5.

33. **Alcedo atthis hispidoides** Lesson

Alcedo hispidoides Lesson, Compl. de Buffon **9**: 345. 1837 (Buru).

A female from Los Negros, taken in April, has a wing measurement of 72.

34. **Halcyon saurophaga admiralitatis** Sharpe

Halcyon admiralitatis Sharpe, Cat. Birds Brit. Mus. **17**: 251. 1892 (Admiralty Islands).

Two males and a female were collected on Hauwei. These specimens measure: wing ♂ 119.5, 121.5, ♀ 121.5. One of the males is molting the wing coverts.

35. **Halcyon sancta sancta** Vigors and Horsfield

Halcyon sanctus Vigors and Horsfield, Trans. Linn. Soc. London **15**: 206. 1826 (Australia).

Three specimens from Los Negros and Pityili in May and July are apparently the first records from the Admiralties for this common migrant.

36. **Cacomantis variolosus blandus** Rothschild and Hartert

Cacomantis blandus Rothschild and Hartert, Nov. Zool. **21**: 290. 1914 (Manus Island, Admiralty Group).

A male and a female were taken on Manus and Pityili. They measure: wing ♂ 113, ♀ 113.5. The form is noted as being "fairly common" on Pityili.

37. **Coracina papuensis ingens** (Rothschild and Hartert)

Graucalus papuensis ingens Rothschild and Hartert, Bull. Brit. Orn. Club **33**: 107. 1914 (Manus, Admiralty Islands).

Two males from Manus and Los Negros, collected in February and March, measure; wing 167, 169.

38. **Rhipidura setosa niveiventris** Rothschild and Hartert

Rhipidura setosa niveiventris Rothschild and Hartert, Bull. Brit. Orn. Club. **33**: 109, 1914 (Manus Admiralty Islands).

Males and females were taken on Los Negros in February, March, April, and May. These birds have wing measurements of: ♂ 89–89.5, ♀ 84, 87. None show signs of molt.

39. **Rhipidura rufifrons semirubra** Sclater

Rhipidura semirubra Sclater, Proc. Zool. Soc. London, 1877: 552 (Admiralty Islands).

Two males from Los Negros in March meas-

ure: wing 69, 70.5. This is the most brilliantly colored race of the species.

40. **Monarcha alecto chalybeocephalus** (Garnier)

Muscicapa chalybeocephalus Garnier, Voy. *Coquille*, zool., Atlas, pl. 15, fig. 1, i, 589. 1826–28 (New Ireland).

Males and a female of this very widespread form were taken on Los Negros, Luo, and Ponam in March, May, and July. They measure: wing ♂ 89, 90, ♀ 82.

41. **Monarcha cinerascens** subsp.

Three males from Herringan and Pityili, taken in April measure: wing 88.5 (2), 90; tail 77.5, 78.5, 79; culmen 19, 20. Birds from the Admiralties and Hermit Islands evidently represent a condition of exact intermediacy in color between the pale, buff-bellied *Monarcha c. perpallidus* Neumann of New Ireland, New Hanover, St. Matthias and Squally Islands, the Tabar Group and Lihir, and the dark, rufous-bellied *M. c. impediens* Hartert of Witu, Feni, and Nissan. In size they are larger than these subspecies. As Dr. Mayr has had a paper in process of publication for some time on these forms, based on the extensive material in the Whitney and Rothschild collections, I prefer to leave the subspecific identification in his hands.

42. **Monarcha barbatus infelix** Sclater

Monarcha infelix Sclater, Proc. Zool. Soc. London, 1877: 552 (Admiralty Islands).

Three males and a female were taken on Los Negros in February, March, and May. The wings of these males measure: 80.5, 83.5, 84.5; culmen 15–16. This is a strikingly patterned form.

43. **Pachycephala pectoralis goodsoni** Hartert

Pachycephala pectoralis goodsoni Hartert, Nov. Zool. **21**: 296. 1914 (Manus, Admiralty Islands)

Two adults and an immature male were taken on Los Negros in February (immature) and May. The adults measure: wing ♂ 91, 93; culmen ♂ 17, 18.

44. **Aplonis metallicus purpureiceps** (Salvadori)

Calornis purpureiceps Salvadori, Atti Accad. Sci. Torino **13**: 535. 1878 (Admiralty Islands).

Adults and immatures were secured in February, March, and May on Los Negros. February and March adults are molting. These birds measure: wing ad. ♂ 104, ♀ 102, 104; tail ♂ 82, ♀ 75, 79; culmen ♂ 18, ♀ 17.5, 18.

45. **Nectarinia jugularis flavigastra** Gould

Nectarinia flavigastra Gould, Proc. Zool. Soc. London, 1843: 103 (New Ireland).

Two males and two females were collected on Butyo and Los Negros in February, March, and May. The March female is in a postjuvenal plumage distinguished by somewhat more fluffy, olivacous feathers on the head and nape. The wing feathers and scapulars are slightly more faded-looking and brownish than in the adult.

46. **Myzomela nigrita pammelaena** Sclater

Myzomela pammelaena Sclater, Proc. Zool. Soc. London, 1877: 553 (Admiralty Islands).

Two males and a female were taken on Hauwei and Ponam. They measure: wing ♂ 75, 75.5, ♀ 67.5; culmen ♂ 17.5 (2).

47. **Philemon albitorques** Sclater

Philemon albitorques Sclater, Proc. Zool. Soc. London, 1877: 553 (Admiralty Islands).

A pair of this large endemic Admiralty Island species were collected on Los Negros in February and March. The female (March) is commencing the molt. These birds measure: wing ♂ 185, ♀ 179; culmen ♂ 48, ♀ 44. Old specimens, even after only 15 years (Whitney collection), become foxed, particularly on the forehead and crown, but also on the back, although Whitney specimens are not so foxed in this respect as are those of the Rothschild collection.

ORNITHOLOGY.—*The races of the violet-crowned hummingbird,* Amazilia violiceps.[1] ALEXANDER WETMORE, Smithsonian Institution.

When Ludlow Griscom (Bull. Mus. Comp. Zoöl. **75**: 378. Jan. 1934) determined that the type specimen of *Cyanomyia salvini* Brewster (Auk **10**: 214. July 1893), described from a bird taken at Nacozari, Sonora, was a hybrid between *Amazilia violiceps* and *Cynanthus latirostris* the status of the Arizona record of a hummingbird under the name *Amazilia salvini* (Brewster) in the fourth edition of the A.O.U. Check-list (1931: 183) was left undecided. The bird in question, from Palmerlee, Cochise County, Ariz., taken on July 4, 1905, was reported under the name *salvini* by Dr. Louis B. Bishop (Auk **23**: 337. 1906). It is now no. 160998 in the collection of the Chicago Natural History Museum. The officials of that institution have kindly lent it to me briefly for examination.

At the same time Dr. Max M. Peet has sent to me for identification a second specimen, from his collection, a male taken by H. H. Kimball near Paradise, Chiricahua Mountains, Ariz., July 16, 1905.

Both of these birds prove to be *Amazilia violiceps ellioti* and are to be recorded as that race, the supposed form *conjuncta* described by Griscom from Sonora proving to be a synonym.

Berlioz (Rev. Franç. Orn., 1932: 129–132, 533–534; 1938: 9–12) and Griscom (Bull. Mus. Comp. Zoöl. **75**: 376–378. Jan. 1934) have cleared up much of the confusion that has existed regarding individual variation in the present species and its geographic forms. Peters (Check-list Birds of the World **5**: 75. 1945) has followed Griscom's arrangement. Determination of the two Arizona specimens has necessitated an examination of the series of the entire species in the National Museum and the Museum of Comparative Zoölogy, with a somewhat different understanding of the forms and of the names that apply to them as a result. My findings are covered in the following brief synopsis, which agrees in the main with Berlioz's determination in 1932 (*l.c.*, p. 132), except that the form he designates *derneddei* is properly called *viridifrons*. The localities in the ranges given below are those of specimens I have handled personally.

[1] Received January 8, 1947.

Amazilia violiceps violiceps (Gould)

Cyanomyia violiceps Gould, Ann. Mag. Nat. Hist. (ser. 3) **4**: 97. Aug. 1859. (Oaxaca.)
Cyanomyia guerrerensis Salvin and Godman, Biologia Centrali-Americana **2**: 290. July 1892. (Rincón, Acahuitzotla, and Tierra Colorada, Guerrero.)
Uranomitra atricapilla Simon, Rev. Franç. Orn. **2**: 129. Aug. 7, 1911. (Oaxaca.)

Definitely shining and metallic above, the coloration of the dorsal surface being darker, the tail coppery color, and the edge of the wing brownish.

Chiapas (Ocozucuautla), Oaxaca (Santa Efigenia, Tapana), Guerrero (Acahuitzotla, Coquillo).

Gould described his bird from Oaxaca, so stating definitely in his original description. This is verified by Hartert (Cat. Birds Brit. Mus. **16**: 196. 1892) in his record of the type, which he says is from Oaxaca. In spite of this, Berlioz has spoken of the birds of Puebla as being typical, though actually they belong to another form, and Peters through a *lapsus calami* has listed the type locality of *violiceps* as Atlixco, Puebla.

Amazilia violiceps viridifrons (Elliot)

Cyanomyia viridifrons Elliot, Ann. Mag. Nat. Hist. (ser. 4) **8**: 267. Oct. 1871. (Putla, Puebla.)
Uranomitra Derneddei Simon, Rev. Franç. Orn. **2**: 129. Aug. 7, 1911. (Puebla.)

Similar to *violiceps* in the coppery iridescence of the tail and brownish edge of the wing, but duller, less metallic above, with the dorsal surface lighter, more brownish.

Puebla (Puebla), Morelos (Cuernavaca, Puente de Ixtla).

This bird is easily distinguished from the typical form on the characters given. The earliest name for it is *viridifrons* of Elliot. As no birds from the state of México are at hand, I am not certain whether they belong to this race or to *ellioti*.

Amazilia violiceps ellioti (Berlepsch)

Uranomitra ellioti Berlepsch, Proc. U. S. Nat. Mus. 9: 561. Sept. 25, 1889. (Mazatlán, Sinaloa.)

Amazilia violieeps conjuncta Griscom, Bull. Mus. Comp. Zoöl. 75: 377. Jan. 1934. (Álamos, Sonora.)

Similar to *violiceps* except that the tail is dull green, not coppery, and the edge of the wing is whitish.

Michoacán (La Salada, Los Reyes, Querén-daro; Jalisco (Guadalajara, Etzatlán, Chapala, Bolaños, Barranca Ibarra); Sinaloa (Plomosas, Mazatlán); Sonora (Álamos, El Tigre Mine); Arizona (Palmerlee, Cochise County; near Paradise, Chiricahua Mountains).

On first examination of the two specimens from Arizona it was presumed that they were to be given the name *conjuncta* of Griscom, but on comparison of material in the U. S. National Museum the characters separating this supposed form from *ellioti* were not apparent. Subsequently J. L. Peters and I compared the original set of birds used by Griscom to find that the skins taken by Frazar that are the basis of *conjuncta* have the exact characters listed in the original description. Study of other specimens from the National Museum, however, showed that Frazar's skins have undergone a post-mortem fading, since material taken by later collectors, some of them from the same locality as Frazar's birds, were indistinguishable from typical *ellioti*. *A. v. conjuncta* therefore is a synonym of *ellioti*.

One specimen in the National Museum from La Salada, Michoacán, has a coppery-colored tail like *violiceps*, indicating some transition toward that form, but others from the same locality have normal green tails.

Birds from Chihuahua (not seen personally) supposedly belong here, but the limits of this race and *viridifrons* need to be established.

ORNITHOLOGY.—*Two new babblers (Timaliidae) from southeastern Asia.*[1]

H. G. Deignan, U. S. National Museum.

I

Through the kindness of the authorities of the Academy of Natural Sciences of Philadelphia and the American Museum of Natural History, I have been permitted to borrow comparative material that enables me to propose two new subspecies of babblers from Siam. The first may be known as—

Stachyris striolata nigrescentior, n. subsp.

Type.—Adult male, U.S.N.M. no. 169854, collected at elev. 2,000 feet on Khao Nok Ra, peninsular Siam at latitude 7°25′ N., longitude 99°55′ E., on January 15, 1899, by William L. Abbott.

Diagnosis.—Nearest *S. s. guttata* (Amherst District, Tenasserim) but distinguished by having the upper parts a darker russet brown; the guttate white spots of the upper back smaller and more numerous, especially at the center of the back; the white spots of the sides of the neck fringed with blackish brown rather than black.

The new race is very distinct from *S. s. umbrosa* (Deli District, northeastern Sumatra) by its *much* less nigrescent upperparts (a majority of my specimens show more or less blackish wash over the pileum, but not elsewhere) and the broader white drops on the upper back and sides of the neck.

No direct comparison has been possible with *S. s. striolata* (Padang Residencies, west central Sumatra). Robinson and Boden Kloss have defined it as much less nigrescent than *umbrosa*, but distinguishable from the bird of peninsular Siam by its more saturate coloration.

Range.—Peninsular Siam from Trang Province north to the Isthmus of Kra; southernmost Tenasserim.

Specimens examined.—S.s. helenae: 2; *S. s. guttata:* 3; *S. s. nigrescentior:* 12; *S. s. umbrosa:* 8.

II

The khatya of northwestern Siam, the Chin Hills of Burma, and presumably of Karenni proves to be racially distinct from the bird of the eastern Himalayas, with which it has been heretofore confused. I suggest that it be called—

[1] Published by permission of the Secretary of the Smithsonian Institution. Received January 24, 1947.

Cutia nipalensis melanchima, n. subsp.

Type.—Adult female, U.S.N.M. no. 330611, collected on Doi Langka (Khao Pha Cho), northern Siam at latitude 19°00′ N., longitude 99°25′ E., on November 6, 1930, by Hugh M. Smith (original number 4292).

Diagnosis.—Nearest *C. n. nipalensis* (Nepal), from which it is inseparable in the male but differs in the female by having the crown a deeper slate and the ground color of the mantle light brownish olive (Ridgway) more or less washed with ferruginous, rather than a uniform bright ferruginous.

From *C. n. cervinicrissa* (Perak) distinguished in either sex by the much lighter and less extensive buffy wash over the white under parts, and in the female by having the mantle distinctly washed with ferruginous.

From *C. n. legalleni* (southern Annam) easily separated in either sex by having the black barring of the under parts restricted to the sides of the body, and in the female by having the crown slate, not brown, and the mantle distinctly washed with ferruginous.

Range.—Northwestern Siam; Karenni?; Chin Hills.

Specimens examined.—*C. n. nipalensis:* 6 males, 6 females; *C. n. melanchima:* 6 males, 7 females; *C. n. cervinicrissa:* 1 male; *C. n. legalleni:* 8 males, 7 females.

Remarks.—In the ground color of the mantle in the female, *melanchima* is almost exactly intermediate between *nipalensis* on the one hand and *cervinicrissa* and *legalleni* on the other, as might be expected from its geographically intermediate range.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

406TH MEETING OF THE BOARD OF MANAGERS

The 406th meeting of the Board of Managers was held in the Library of the Cosmos Club on Monday evening, February 17, 1947, President SCHMITT presiding. The following persons were present: H. S. RAPPLEYE, N. R. SMITH, F. M. SETZLER, W. N. FENTON, H. B. COLLINS, JR., W. W. DIEHL, F. G. BRICKWEDDE, F. L. MOHLER, J. S. WADE, C. F. W. MUESEBECK, W. W. RUBEY, L. E. YOCUM, W. A. DAYTON, C. A. BETTS, A. O. FOSTER, H. G. DORSEY, O. B. FRENCH, C. L. GAZIN, W. L. SCHMITT, and, by invitation: G. P. WALTON and A. STONE.

The following appointments were announced:

Appointed Members on the Executive Committee: N. R. SMITH and F. L. MOHLER.

Archivist: N. R. SMITH was reappointed for a term of three years.

Committee on Meetings: GEORGE P. WALTON, Chairman, G. W. VINAL, A. R. MERZ, E. H. GRAHAM, and S. F. HILDEBRAND.

Committee on Membership: W. W. DIEHL, Chairman, C. W. EMMONS, C. W. COOKE, J. W. MCBURNEY, E. W. PRICE, W. D. SUTCLIFFE, and M. H. MARTIN.

Board of Editors of the Journal: ALAN STONE. W. N. FENTON was designated Senior Editor. R. E. BLACKWELDER was appointed Associate Editor for a term of three years to represent the Entomological Society of Washington.

Committee on Monographs: E. A. CHAPIN, Chairman, E. P. KILLIP, C. W. REES, NORMAN BEKKEDAHL, and W. R. WEDEL.

The Board of Managers authorized the President to form two other committees: one to consider the JOURNAL and its improvement, the other to make recommendations for the observance of the 50th anniversary of the ACADEMY, which falls on February 18, 1948. Appointed to the first of these committees were: R. J. SEEGER, Chairman, W. N. FENTON, G. A. COOPER, L. V. JUDSON, and H. A. REHDER. Appointed to the second of these committees were: F. M. SETZLER, Chairman, C. B. CLAUSEN, E. W. PRICE, C. E. CHAMBLISS, H. S. BERNTON, GILBERT GROSVENOR, C. L. GARNER, E. C. CRITTENDEN, H. G. DORSEY, W. W. RUBEY, and F. G. BRICKWEDDE.

The Board approved the Treasurer's budget for the year. This represented an increase of $950 over the budget for 1946, and consisted of the following items:

Secretary	$ 400.00
Treasurer	250.00
JOURNAL:	
Printing and Mailing	4,000.00
Office Clerk	300.00
Miscellaneous	50.00
Custodian and Subscription Manager	100.00
Meetings Committee	450.00
Directory	350.00
Total	$5,900.00

The greatest increase was in the printing and mailing of the JOURNAL, and this was due wholly to increased printing costs. The office clerk was given an annual increase of $60, and the Meetings Committee an increase of $50, restoring its allotment to the pre-war figure. Fifteen dollars was added to the amount budgeted last year for the directory yet to be authorized by the Board.

Mr. RAPPLEYE reported his authorization by the Executive Committee for the purchase of $2,000 of U. S. Government Savings Bonds, Series G.

The Secretary was authorized to include with the next meetings notice a card requesting members to consider the JOURNAL as a ready means of publication.

Mr. WALTON, Chairman of the Committee on Meetings, announced that the policy for the coming year was to secure Nobel prize winners as speakers so far as possible.

The Secretary reported the death of the following members: HENRY G. AVERS, of the U. S. Coast and Geodetic Survey, and former Treasurer of the ACADEMY, on January 19, 1947; CHARLES ALBERT BROWNE, formerly of the Bureau of Chemistry and Soils, on February 3, 1947; JAMES HARWOOD JEANS, honorary member, formerly of Dorking, England, on September 16, 1946; and WILLIS L. JEPSON, formerly of the Department of Botany, University of California, on November 7, 1946.

C. LEWIS GAZIN, *Secretary.*

ANTHROPOLOGICAL SOCIETY

The Anthropological Society of Washington at its annual meeting, held January 21, 1947, elected the following officers: President, REGINA FLANNERY; Vice-President, WILLIAM N. FENTON; Secretary, MARSHALL T. NEWMAN; Treasurer, JOHN C. EWERS; Councilors to the Board of Managers, W. M. COBB, W. H. GILBERT, JR., RUTH E. PARDEE, D. B. SHIMKIN, G. R. WILLEY.

A report of the membership and activities of the Society since the last annual meeting follows:

Life members, 1; Active members, 62; Associate members, 26; total, 89. This represents a loss of eight since last year.

The members elected during the year were: Active members—Dr. MARSHALL T. NEWMAN, Mrs. EMIL SADY, Dr. CHARLES E. TUTHILL. Associate members—Dr. E. S. C. HANDY, Dr. JULES HENRY, Dr. OLAV R. T. JANSE, Dr. LAURISTON R. SHARP, Mrs. ROSAMOND B. SPICER, R. M. TATUM.

The Society records its deep sense of loss in the death of Dr. GEORGE S. DUNCAN, Past President and member since 1930.

The report of the Treasurer follows:

Funds invested in Perpetual Building Association (with interest to December 31, 1946)		$1,899.12
21 shares Washington Sanitary Improvement Co. (par value $10 per share)		210.00
2 shares Washington Sanitary Housing Co. (par value $100 per share)		200.00
U. S. Savings Bond, Series G		500.00
Cash in bank		262.62
		$3,071.74
Bills outstanding:		
To American Anthropological Association (subscription to American Anthropologist for one member at $5)	$ 5.00	
		3,066.74
Total as of December 31, 1945		2,913.04
Increase		$ 153.70

A spring dinner was held at the Zoo Restaurant, May 14, 1946; but all regular meetings were held at the U. S. National Museum. The Program Committee for the season, appointed in October 1946, was comprised of Dr. MARSHALL T. NEWMAN, Chairman, Dr. MARGARET LANTIS, and Dr. RUTH PARDEE.

Titles of papers presented before the regular meetings of the Society were as follows:

January 15, 1946, 732d meeting, WILLIAM M. SHANKLIN, *The anthropology of the Arab Bedouin*" (slides).

February 19, 1946, 733d meeting, J. M. COWAN, *Wartime activities of linguists* (recordings).

March 19, 1946, 734th meeting, CORA DUBOIS, *Anthropology in Government.*

April 16, 1946, 735th meeting. T. DALE STEWART, *Anthropology and the melting pot* (slides). Address of the retiring President.

October 15, 1946, 736th meeting, WILLIAM N. FENTON, *Problems of folklore research, illustrated by materials from the Eastern Woodlands* (recordings).

November 19, 1946, 737th meeting, GORDON T. BOWLES, *The impact of the War upon the Japanese people.*

December 17, 1946, 738th meeting, MARY L. DEGIVE and MARGARET CUSSLER, *Hopi horizons* (Documentary film, first showing).

The Society voted to affiliate with the Washington Social Science Federation, and the Secretary represented the Board at a preliminary organization meeting, but the Federation remains in abeyance until other groups of social scientists organize locally.

WILLIAM N. FENTON, *Secretary*

Obituary

GERALD FRANCIS LOUGHLIN was born in Hyde Park, Mass., a suburb of Boston, on December 11, 1880. He died suddenly at his home in Washington, D. C., on October 22, 1946.

His early education was obtained in the public schools of his native community and the Boston Latin School. He graduated from Massachusetts Institute of Technology in 1903 with the degree bachelor of science in mining geology. He was awarded the degree doctor of philosophy by Yale University in 1906. From 1906 to 1912 he taught geology at the Massachusetts Institute of Technology and also gave courses at nearby Tufts College and Boston University.

He was a fellow of the Geological Society of America and of the Mineralogical Society of America and a member of the Society of Economic Geologists, the American Institute of Mining and Metallurgical Engineers, the American Association of Petroleum Geologists, the American Association for the Advancement of Science, the American Geophysical Union, the Washington Academy of Sciences, the Geological Society of Washington, Sigma Xi, and the Cosmos Club.

After a summer as field assistant with the United States Geological Survey he served two years (1904–1906) as a geologist with the Connecticut Natural History Survey. For this bureau he made a survey of the clays and clay industries of the State, and in collaboration with Joseph Barrell he also prepared a report on the lithology of Connecticut.

Between 1906 and 1912 Dr. Loughlin worked during summers for the United States Geological Survey, and in 1912 he joined the permanent staff as associate geologist. From 1917 to 1935 he served successively as geologist in charge of the sections of nonmetallic and of metallic resources in the former Division of Mineral Resources, then as chief of that division, and later as chief of the Section of Metalliferous Deposits. In 1935 he was made chief geologist of the Geologic Branch, a position he held until July 1944, when after 27 years of administrative services he was relieved of such duties and appointed staff scientist. This gave him opportunity to resume geologic research in New England, to which he had long looked forward. He brought to this new work renewed eagerness and enthusiasm, a wealth of broad experience, a practical scientific imagination, and a definite promise of further important accomplishments. His untimely death prevented completion of any part of this work.

Dr. Loughlin's specialities were ore deposits and constructional materials, but his interests and abilities extended much more broadly, into the fields of igneous petrology, structural geology, and metamorphism. His bibliography is large, and his writings show soundness and versatility. He wrote with an uncommon degree of clarity, but he achieved simplicity and conciseness in his writings without any sacrifice of contributory services to the science. As an adviser in the field and office he was generous of his time and interest, always ready with helpful suggestions, a teacher and a counselor in the most felicitous sense. Had his activities not been limited by confining administrative duties, he would doubtless have contributed even more, and always valuably, to the funda-

mentals of geologic science through zealous, sound, and practical research.

In this short space it is not possible to review his geologic work specifically, but it is in order to remark upon the general importance of his contributions. He was an authority in the field of constructional materials and was well known and regarded highly by the industry, so that his advice was solicited frequently. To the geologic profession, however, he was known best for his work on metalliferous deposits, for which he has ranked high among economic geologists. He contributed largely to the science of ore deposits and specifically to the geology of mining districts in Utah, Colorado, and New Mexico. After it was realized in 1910 that large deposits of oxidized zinc ores were present in the Leadville district and had long been overlooked, Loughlin was detailed to study the ores. His report on this subject is outstanding. S. F. Emmons had already begun a comprehensive study of the district, and after his death J. D. Irving continued the work. Irving's death in 1918 left completion of the report to Loughlin who had reviewed the work with Irving, and he was, therefore, as he put it, "the most available to inherit the task" of assembling and preparing for publication the classical professional paper on *Geology and ore deposits of the Leadville mining district, Colorado* (1927). It was a tremendous job of critical assembling and collating of data, but he possessed rare ability in such lines, and the resulting report was monumental. Later he made extensive studies in the Cripple Creek district and recognized the unusual and complicated nature of the structural control on the localization of ores in the "crater" or basin. He published several papers relating to the modes of occurrence and finding of ore both at Cripple Creek and at Leadville.

His chief hobby was music, and he composed and arranged scores. For a long time he was director of an orchestra composed of young people of All Soul's Unitarian Church, and at various times he directed choral groups, some of which were composed wholly of Geological Survey personnel. Until administrative duties demanded too much of his time and energy he was a principal organizer and contributor to the Pick and Hammer shows.

He was fond of sports, and of young people, with whom he delighted to work and play. He was ever gentle and understanding with youngsters, whether his own grandchildren in whom he took great pleasure, or the neighborhood gang whose scrub baseball games in the vacant lot or in the street sometimes brought him to the scene, not as spectator, but as an active participant. Broken glasses and bruises sometimes brought a resolve to be more circumspect, but happily the resolution would soon be forgotten. He loved to talk of batting averages and the life histories of major league baseball players of the past and present with his young friends.

He was a fond and devoted family man. He had a warm liking, too, for his fellow men and never took intentional advantage of anyone. He always wanted to be friendly, but he was naturally reserved and undemonstrative and as a consequence was often misunderstood. Beneath a rather solemn mien, which was begot of natural shyness, there was a ready, deep sense of humor that sometimes sparkled with dry, good-natured satire but was never mean or bitter. In a way he was a contradiction; his shyness and reserve were abandoned when he disported in a Pick and Hammer show, and he delighted the audiences with his antics and excellent mimicry.

Gerald Loughlin never shirked a duty, and he never sought prominence. He was systematic and conscientious in the performance of his offices, and his greatest satisfaction was obtained by accomplishing his tasks as he thought they should be done. He was incapable of subterfuge or pretentiousness. Personal gains were never considered in making his decisions. But he looked into his heart as well as his head, and he did what he thought was justly demanded by the particular circumstances. His New England conscience forbade either disloyalty to or exploitation of others. He was a good citizen. It was a part of his fiber that he should always do what the honesty of his soul demanded, so that he seemed indeed to live by the precept—

> To thine own self be true,
> And it must follow as the night the day
> Thou canst not then be false to any man.

L. W. Currier
J. S. Williams

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LINGUISTICS.—*The word for seal (Pinnipedia) in various languages.*[1] JOHN P. HARRINGTON, Bureau of American Ethnology.

The main industry of the Pribilof Islands, situated in the southern part of the Bering Sea, concerns itself with the fur seal (*Callorhinus ursinus cynocephalus*). It is there that the fur seal breeds, under the protection of the United States Government's Fish and Wildlife Service, and that the harvested skins are partially prepared for making into coats or the like. It was while making a study of the Aleutian language on the island of St. Paul, the larger one of the two main Pribilof Islands, that I noticed that although Aleutian has several words for various aspects of the fur seal, these words are all age-sex descriptions or are derived from Russian—with one sole exception, lakúðax̣, the name of the fur seal itself. These facts allow of only one interpretation, which is that originally there was in Aleutian only one word for fur seal, and that all the other words are modificatory terms that have grown up with the development of the industry.

The name for seal most widely spread in languages means sea-dog, sea-wolf, sea-calf, sea-cat, or sea-bear, or some one of these designations with the combining form sea- omitted, this terminology being part of a gigantic extension of terms denoting land animals into the realm of ocean. The seal is bewhiskered and sly and therefore lends itself to these appellations. Some other languages have a special word for seal, or words for two or more species of seal, words which are different from anything else.

Although especially sea-calf is largely used in English dialects, the standard high English word for the animal is "seal," pronounced siil, these terms having been applied in early times notably to *Phoca vitulina*, common seal, the species most usual off the shores of the islands of Britain and Ireland. The curious feature of the word "seal" is that it still appears in certain of its forms in Anglo-Saxon (alias Old English) with a final h, which is a remnant of an erstwhile syllable -kos. Several Sanskrit names of animals end in -kas, or this ending alternates with its lack. The declension in Anglo-Saxon of the word for seal is:

	Sing.	*Bpl.*
NOM.	seolh	sēalas
GEN.	sēoles	sēala
DAT.	sēole	sēalum
ACC.	seolh	sēalas

The h even in Anglo-Saxon disappeared except where it is etymofinal. The vowel-breaking of this word in Anglo-Saxon comes not from an ancient diphthong, but from the vowel e being before, or having been before, lh, while vowel harmony makes the breaking vary between ēo and ēa. Modern Swedish has a survival of this breaking in its secondary form of säl, seal, which is själ. (See below.) Scotch and Irish dialects of English overdo the h into x̣ the standard spelling having sealch, seal, the pronunciation being selx̣, while the Shetland Island dialect of English has in standard orthography sealkie, pronounced sēlki. The word for seal in English prior to the recording of English, that is, prior to all vowel breaking, was *selh, with which one can nicely compare Old High German sēlah, seal, with an a which has crept in between the l and the h. The Indo-European form of the word would have been *selkos, the Gothic form would have been *silhs. Old Icelandic selr has already lost its h and goes back to *selhr. As combining form Old Icelandic has the very primitive form sel-, oc-

[1] Received January 22, 1947.

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curring for instance in sel-skinn, sealskin. What sel- is still further to be connected with, if with anything, nobody knows; connection with soul, which in the Gothic form of the word is saiwala, is plausible.

The German language has as its probably commonest word for seal: Seehund, falsely taken to have the etymology sea-dog, but Danish selhund, seal, shows that this German word may have seal sticking in it as its first half. The other common German word for seal is Robbe, feminine, of Low German origin, naturally since Low German is the more maritime and original variety, and without any linking or etymology that is certain.

The Danish-Norwegian word for seal is sel or sælhund. One should notice that the vowels of the first word and of the first syllable of the second word differ in speaking and pronunciation. The regular Swedish word for seal is säl, but the dictionaries carry a much less used byform, själ, pronounced šäl and sounding exactly the same as själ, soul, only själ, seal, is masculine and själ, soul, is feminine. This secondary word for seal in Swedish is interesting in that it still preserves the olden vowel-breaking that is preserved in English orthography, as has been stated above. A third Swedish term for seal is sälhund, literally seal-dog. But *själhund is never formed for seal; it would be taken to mean soul-dog. There is still another word for seal both in Danish-Norwegian and in Swedish. It is kobbe, which reminds one in its sounding, except for the first letter, of German Robbe, seal. This word, kobbe, appears in Old Icelandic as kobbi, seal.

Old Icelandic has selr, seal, also kobbi, seal, which has just been mentioned. Old Icelandic has also kópr, young seal, which is the same word as English cub, applied in English to a young bear.

The Irish Celtic language has rón, seal. A Scotch Gaelic dictionary gives the same word merely with the different spelling ròn. The Welsh language has as its most standard word for seal: morlo. This word patently says sea-calf. The common Welsh word for sea is môr, whereas llo, pronounced Lo, is the ordinary Welsh word for calf. One can also, but rarely does, in Welsh say llo môr for seal.

The word for seal in Old as well as in Modern Greek, and doubtless in early times applied especially to *Monachus monachus*, which is the species common to Greek waters and to the Mediterranean in general, was, and is, phóokee, feminine, connected with Old Greek phúusa, a pair of bellows, phuusáoo, I blow, I puff, doubtless because the seal had as one of its characteristics that of being a blower. Phóokee is one of the Indo-European animal names in -kos; like Latin vetula it appears regularly in the feminine, oo ablautes with uu.

Latin had as its own native word for seal, vitula, which is nothing but the feminine of the ordinary Latin word for calf: vitulus. Slavic and Sanskrit suggest that Latin vitulus in origin means little-yearling, connected with Latin vetus, old, having years. The Albanian language calls calf vjete, which reminds one of the Latin word. The Greek word for seal, phóokee, was early taken into Latin as phoca, a spelling phoce also occurring, and one can still say in Spanish foca, as well as to call a seal a sea-wolf.

Lithuanian and the related Lettish language have as the word for seal: ronis, reminiscent of the Irish word given above, though exact equivalence is difficult to show. German Robbe, seal, starts off the same way.

The Russian language has four words meaning seal. Two of these four terms are, or are derived from, the word for cat. The most distinctive word for seal, which comes quickest perhaps to a Russian's mind, is $t^{y}ulén^{y}$, which refers perhaps especially to hair seal, but is also the word for seal in general. A word nérpa, meaning especially hair seal, and unknown to many Russians, is of Karelian origin and has in origin been picked up from Finnish norppa, marble-seal. Russian morskóy kót, sea-cat, is largely used for the seal, or one says kot, with morskóy understood. Kot in terrestrial application signifies a tom-cat. The corresponding feminine is of course morskáya kótcka, or merely kótcka. The fourth term is kótik, in origin a diminutive of kót. Kótik has become standardized to be the regular name of the fur seal. The first and third of the Russian words given above also

have usage with metaphorical meaning: tʸulénʸ means a clumsy person, kót a bully.

The regular Finnish word for seal is hyle. Norppa, marble-seal, is not to be found at all in one Finnish dictionary.

BOTANY.—*The Amazonian varieties of* Lonchocarpus nicou, *a rotenone-yielding plant.*[1]

FREDERICK J. HERMANN, U. S. Department of Agriculture.

Exploration of the *llanos* and *selvas* of eastern Colombia in 1944 for additional sources of rotenone-yielding plants disclosed the frequent occurrence there of two *barbascos* of economic value. One of these was *Lonchocarpus urucu* Killip & Smith, until then definitely known only from Amazonian Brazil and a single locality in Colombia[2] but suspected to extend into Peru and Venezuela. The second and commoner of the two *barbascos* (which, as is so generally the case, were found only in sterile condition) was thought to be either *L. utilis* A. C. Smith or *L. chrysophyllus* Kleinh., until firsthand acquaintance with *L. utilis* at Iquitos revealed discrepancies from the Colombian plant and subsequent study of authentic material of *L. chrysophyllus* in the herbarium showed that reference of the Colombian collections to this concept was equally unsatisfactory. They appear, however, to be a very good match for specimens annotated by Krukoff and Smith as their "*Lonchocarpus* sp. No. 10" (Amer. Journ. Bot. **24**: 584. 1937), said to occur "in the region of the Amazon delta and also in Surinam and British Guiana."

Intergradations in morphological characters among all these plants were found to be so frequent in Colombia that great difficulty was often experienced in arriving at a satisfactory disposition of a given collection; indeed, intermediates between *L. urucu* and "Krukoff & Smith No. 10" seemed to be the rule rather than the exception. For this reason it seems better to treat them as geographic varieties of the polymorphic *L. nicou* (Aubl.) DC. rather than to continue the attempt to maintain them as specific entities. The following new variety and new combinations are therefore proposed. Because the plants have been so little known in Colombia, collections of the two varieties found in that country by the writer are cited. Abbreviations employed for the herbaria containing these specimens are: C (Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá); NA (U. S. National Arboretum Herbarium, Beltsville, Md.), and US (U. S. National Herbarium, Washington, D. C.). All localities are in Colombia.

Lonchocarpus nicou (Aubl.) DC., var. **languidus,** var. nov. (*Lonchocarpus* No. 10, Krukoff & Smith, l.c.).—A varietate typica recedit foliolis papyraceis longioribus (16–32 cm) longe acuminatis, sensim in apicem gracilem (2–4 cm) productis, nervibus secondariis arcuatim adscendentibus.

The large papyraceous leaflets with very long tips (averaging 3.5 cm) are characteristic of this variety.

INTENDENCIA DEL VICHADA: Deep forest (Monte Arrojo) on llanos along the Río Vichada, 7 km northeast of San José de Ocuné, 10982 (C; US); same, 27 km northeast of San José de Ocuné, 11005 (C;NA;US) (approaching var. *urucu*). INTENDENCIA DEL META: Bank of small stream in dense forest (Monte de Machadero, Ocoa), 4 km southeast of Villavicencio, 11123 (C;NA—TYPE;US); same, 11128 (US); dense forest (Restrepo Woods), 6 km north of Villavicencio, 11150 (US); dense forest (Ladorada Marayal de San Martín), 16 km northwest of San Martín, 11177 (C;US) (approaching var. *urucu*); forest near the Río Meta, ¼ km east of Puerto López, 11209 (C;US) (approaching var. *urucu*). COMISARIA DEL CAQUETA: Forest near mouth of Quebrada Las Dalias on the Río Orteguaza, La María (Hacienda de Ramón Achiardy), 23 km southeast of Venecia, 11225 (C;US) (approaching var. *typicus*); same, 11228 (C;US) (approach-

[1] Received January 3, 1947.

[2] El Porvenir, on the Río Meta, according to G. Gutierrez (*Estudio sobre los principales barbascos colombianos*, Supl. Revista Agr. y Ganad., 1943: 22)

ing var. *urucu*). INTENDENCIA DEL AMAZONAS: cultivated at Leticia, 11289 (NA) (approaching var. *urucu*); inundated jungle on the Río Hamaca-yacu, 70 km northwest of Leticia, 11310 (C;NA;US).

Lonchocarpus nicou var. **urucu** (Killip & Smith), comb. nov. (*L. urucu* Killip & Smith, Journ. Washington Acad. Sci. **20**: 81. 1930).—Distinguished vegetatively from typical *L. nicou* and its other varieties by the abruptly short-acuminate leaflets, the tips not over 1 cm long. The leaflets are also more thickly coriaceous than in any of the other varieties.

INTENDENCIA DEL VICHADA: Thicket along the Río Muco near Mutua, 60 km northwest of San José de Ocuné, 10938 (C;NA;US) and 10945 (US); same, cultivated on Canuco de Segundo Gallardo, 10940 (C;NA;US); deep forest (Monte Arrojo) on llanos along the Río Vichada, 7 km northeast of San José de Ocuné, 10980 (C;NA;US) and 10981 (C;US).

Lonchocarpus nicou var. **utilis** (A. C. Smith), comb. nov. (*L. utilis* A. C. Smith, Amer. Journ. Bot. **24**: 580. 1937).—Leaflets usually longer and narrower than in vars. *typicus* and *urucu*, oblong-elliptic or elliptic-lanceolate and gradually acuminate at the apex. The secondary nerves are curved rather than straight and ascending as in the typical *L. nicou*.

In view of a recent tendency to submerge the extensive and predominantly American genus *Lonchocarpus* in the chiefly Asiatic *Derris*, some apology for the continued advocacy of the segregation of *Lonchocarpus* may be called for. There can, of course, be little question of the expediency of maintaining the long-established name *Lonchocarpus* from the standpoint of the economic botanist and of all those who have a commercial interest in the plants and who find in the generic distinction a convenient means of differentiating between the principal American source of rotenone and the Asiatic source. The arguments for the incorporation of *Lonchocarpus* in the genus *Derris* have been most recently summarized by J. Francis Macbride in his *Flora of Peru* (Publ. Field Mus. Nat. Hist. (Bot. Ser.) **13** (pt. 3, no. 1): 256–259. 1943). Although one can readily agree in principle with much of this argument, it does not seem definitively to establish the necessity for combining the two genera. Little, if anything, new is added to the accumulated data pertaining to the two groups by this summary, wherein reliance is placed chiefly

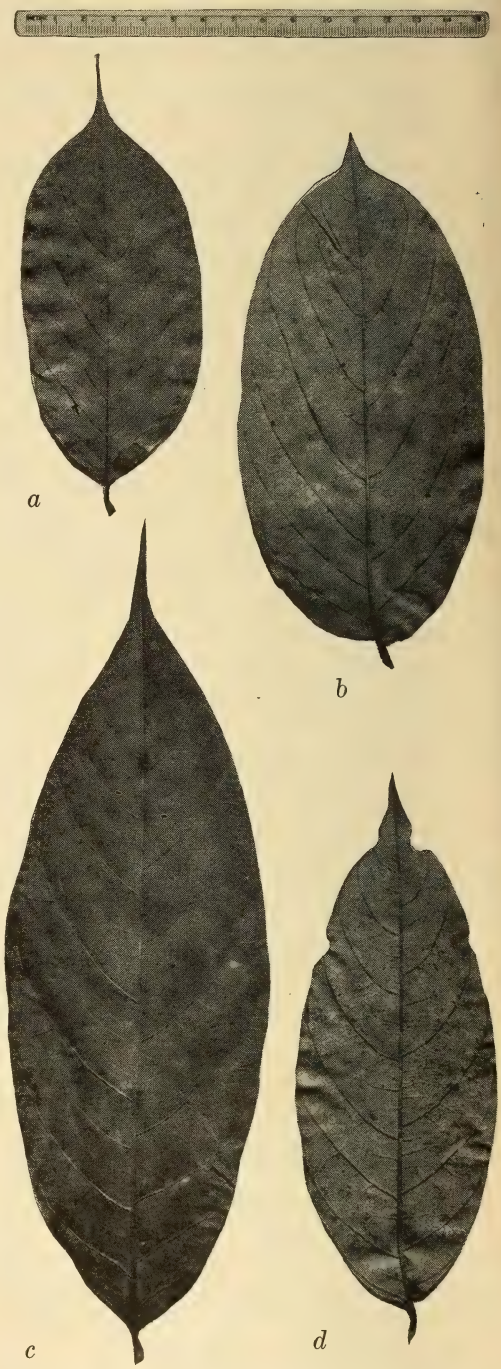


FIG. 1.—Typical leaflets of varieties of *Lonchocarpus nicou: a*, var. *typicus* (*Archer* 2936); *b*, var. *urucu* (*Hermann* 10980); *c*, var. *languidus* (TYPE, *Hermann* 11123); *d*, var. *utilis* (*Krukoff* 7684).

upon the observations and speculations of Bentham whose conclusions upon the question have been on record for the past 85 years and which nevertheless have not been put into practice by the majority of botanists who have studied the plants. It is significant that Bentham was not sufficiently persuaded of the validity of his own conclusions to adopt them himself. Bentham's statement, "We must take natural genera only . . . uniting *Lonchocarpus, Pongamia, Piscidia* and *Muellera* with *Derris* . . . ," is quoted in favor of the argument to abolish *Lonchocarpus*, yet it is later admitted that Bentham himself did not merge *Pongamia, Piscidia* and *Muellera* with *Derris* but retained them as distinct genera as he did, for that matter, *Lonchocarpus*.

Macbride's own suggestion for the disposition of some of these supposedly theoretical genera would appear to raise further questions. "*Pongamia* and *Piscidia*," he says (l.c. 258), "are evidently only extreme developments in the fruit and thus while purely academic may, especially in floristic work be conveniently recognized." If *Pongamia* and *Piscidia*, admittedly "purely academic," may be retained as a matter of convenience, why not also *Lonchocarpus*? The apparent implication in the same quotation that we are to recognize one standard or usage in monographic work and another in floristic raises the natural query why, if we are to permit two separate standards within the field of systematic botany, we should not make a like concession to a field as distinct as economic botany, in which *Lonchocarpus* plays its principle role. But the innovation of sanctioning a double nomenclatorial standard, considered from almost any standpoint, would conceivably accomplish little but the transfer of complications from one locus to another.

Lonchocarpus has been an almost universally recognized genus for over a century and the evidence now on hand does not appear to the writer to be sufficient to warrant its unequivocal submergence in *Derris*. There is just as much reason to unite, for example, *Aster* and *Erigeron* into a single genus as *Lonchocarpus* and *Derris*, yet few botanists would seriously consider such a step.

It does not seem advisable to advocate the change of names that are in widespread commercial use until taxonomists themselves are essentially in universal agreement upon the necessity for such changes within their own field. The policy of suggesting nomenclatorial changes profoundly affecting fields outside of pure taxonomy in accordance with temporary viewpoints too often results in the necessity of a periodic shuffling back and forth from one name to another until taxonomists have reached agreement among themselves—and it is understandable that this does not enhance the popularity of taxonomic research.

ENTOMOLOGY.—*New Guinea species of mosquitoes of the genus* Aedes, *subgenus* Aedes.[1]

WILLARD V. KING, Colonel, and HARRY HOOGSTRAAL, Captain, Sn.C., AUS. (Communicated by ALAN STONE.)

Seventeen species of subgenus *Aedes*, of which 12 were described as new, are recognized herein from New Guinea and islands immediately adjacent. In addition, reference is made to two species occurring in Australia and to several unidentified forms encountered in New Guinea. The taxonomic study of the group has been distinctly handicapped by inadequate material, especially the lack of reared series in which both sexes and the larvae were definitely associated. The present classification is based primarily on the male genitalia, which fortunately present good distinctions. The female is known in 11 of the 17 species and the larva in only 5.

The main recognition characters of the

[1] From the 19th Medical General Laboratory, U. S. Army. Contribution No. 14 from the Entomology-Mammalogy Department. Received January 16, 1947.

The authors are greatly indebted to Dr. Alan Stone for much advice and assistance in this study, and both to him and C. F. W. Muesebeck for making available the material and facilities of the Division of Insects of the U. S. National Museum. They are indebted also to Jean Laffoon for helpful suggestions.

subgenus *Aedes*, as defined by Edwards (1932), are as follows: Palpi very short in both sexes; proboscis, wings, and tarsi uniformly dark; male antenna densely plumose; recumbent scales of head mostly broad and flat; scutellar scales narrow; lower anterior mesepimeral bristle lacking, but usually a group of fine hairs posteriorly; tarsal claws either simple or toothed; phallosome simple, divided into a pair of plates or rods; harpago (claspette) lacking; eighth segment of female abdomen retractile, the cerci moderately long and slender.

Common characteristics among the New Guinea species may be given here and, to save repetition, omitted in the individual descriptions except to note variations: Proboscis distinctly longer than femur; head scales usually all flat and all dark except for a lateral stripe of creamy-white ones, sometimes a median stripe of broad white scales, or some narrow white scales on the nape, the midline, or eye margin; *apn* (anterior pronotum) bare of scales or with an occasional broad one (heavily scaled in one species, *lineatus*); *ppn* (posterior pronotum) with 4 to 6 posterior bristles, either bare of scales or with narrow dark ones on upper half and occasional broad ones below, sometimes a few hairs in front of the lower bristles; scutum with fine or narrow curved scales, usually with little or no ornamentation; patches of broad, usually white, scales on the upper and lower posterior sternopleuron and at about the upper third of the mesepimeron; propleuron with flat white scales and 6 to 8 bristles; sternopleuron sometimes with scattered small fine hairs; mesepimeron with a small group of hairs around the lower posterior corner of the scale patch or with most of the lower half hairy (all New Guinea species with some hairs); meteusternum (sclerite below the posterior spiracle) bare; lateral scales of the apical part of veins 2 to 4 usually elongate and somewhat spatulate, the tip distinctly broader than at basal third; hind tarsal claws simple so far as observed; fore and mid claws of male usually unequal and simple, of the female equal in size and frequently with a minute tooth, sometimes simple or with a large tooth; abdominal tergites III–VII (sometimes II and VIII) with white markings, either lateral spots (usually "oblique") or dorsal transverse bands.

A characteristic of the male genitalia of the New Guinea fauna is the comparative simplicity of the coxite (basistyle), most of the species lacking the apical extension and the elongate lobes or arms found in practically all Oriental species. This has greatly reduced the problem of comparison with species of adjacent regions. Instead of such processes, a majority of the New Guinea species have one or more thick spines or small leaflets arising from the inner margin of the lower fold, subapically. Two of the species in the New Guinea list (*neomacrodixoa* and *panayensis*) and one from Australia (*A. cunninghami* Taylor) have a more complicated structure.

About midway of the inner margin of the lower fold of the coxite is a group of two or more slender bristles set in rather prominent tubercles. This is referred to as the median lobe. The basal lobe is represented by a flat area minutely pilose and bearing a few fine hairs. The style (dististyle) is attached near the apex of the coxite. Its basal third is more or less enlarged while the apical two-thirds forms a wide flattened arm, more or less curved or bent, without an apical appendage. The ninth tergite usually is emarginate posteriorly and bare of hairs; the ninth sternite usually with a posterior row of five setae (two short ones alternated with three longer ones). The anal membrane is indented posteriorly, the paraproct undeveloped and usually represented by only a very slight lateral thickening.

With the possible exception of *neomacrodixoa*, all the New Guinea species have a peculiar H-shaped structure visible below the anal membrane, the homology of which has not been determined. It appears to be a bridging of the dorsal arms of the tenth sternite, with flattened posterior projection on each side made up in some cases of a number of elongate, closely appressed, rounded filaments, and in others of a striated leaf-shaped membrane. These arms lie in a perpendicular plane and their formation is difficult to see except in mounts where they happen to have become flattened (see Figs. 12 and 16). A somewhat similar bridge has been observed in some of

the Philippine species (including *panayensis*) but the posterior arms are less developed or absent, and nothing comparable to the filaments was noted.

The female genitalia of the New Guinea group seem to be very uniform and simple in structure, and unfortunately, offer little assistance in identification. This was first pointed out to the writers by J. Laffoon. With better material, it is possible that a more thorough study than we have attempted would disclose useful characters.

The larvae (so far as known) have a spiculate antenna, a single row of comb scales, the last 1 to 3 pecten spines more widely spaced than the others, anal segment not completely ringed by the saddle and 1 to 3 small ventral precratal tufts present.

Only one Oriental species, *panayensis* of the Philippines, is definitely known from the New Guinea region. Another species, *neomacrodixoa*, is closely related to the Philippine *macrodixoa*. Two common New Guinea species, *carmenti* and *lineatus*, occur in the Solomons and the Moluccas, and *carmenti* in northern Australia also. (*A. ceramensis* Brug from Ceram is considered a synonym of *carmenti*.) The Australian species *funereus* has a limited distribution in New Guinea. Two Malayan species, *A. butleri* Theobald and *A. incertus* Edwards, have been reported from New Guinea, the former from Pionierbivak (Brug, 1923) and the latter from Merauke, Papua (Edwards, 1924). The identification of the first was probably based on females and was probably incorrect. At least none of the males examined by us resemble the male of *butleri*. The male of *incertus* is unknown but the Merauke record for this species was based on a male specimen (for which the genitalia were not described), which Edwards said agreed with females from the Malay Peninsula. The record now seems very doubtful. As described by Leicester (1908) under the preoccupied name of *taeniata*, *incertus* differs from all our species in having a combination of broad basal bands on the tergites (median spots only on the paratype), tarsal claws toothed, and a median line of narrow pale scales on the head.

Several of the species are common and widely distributed in New Guinea. The adults are often extremely annoying in the forest during the day. A number of the species in the Hollandia area were obtained only from light trap collections. Larvae of New Guinea species so far as known have been taken only from ground pools.

The previously described species are discussed first, followed by descriptions of new species, each group being arranged in alphabetical order. Keys to adults, male genitalia and larvae are provided at the end.

Aedes (Aedes) carmenti Edwards

Aedes carmenti Edwards, Bull. Ent. Res. **20**: 388. 1924. (Type female, with numerous other specimens, from Maravova, Guadalcanal, Solomon Islands, and one female from Palm Island, North Queensland, Australia.)

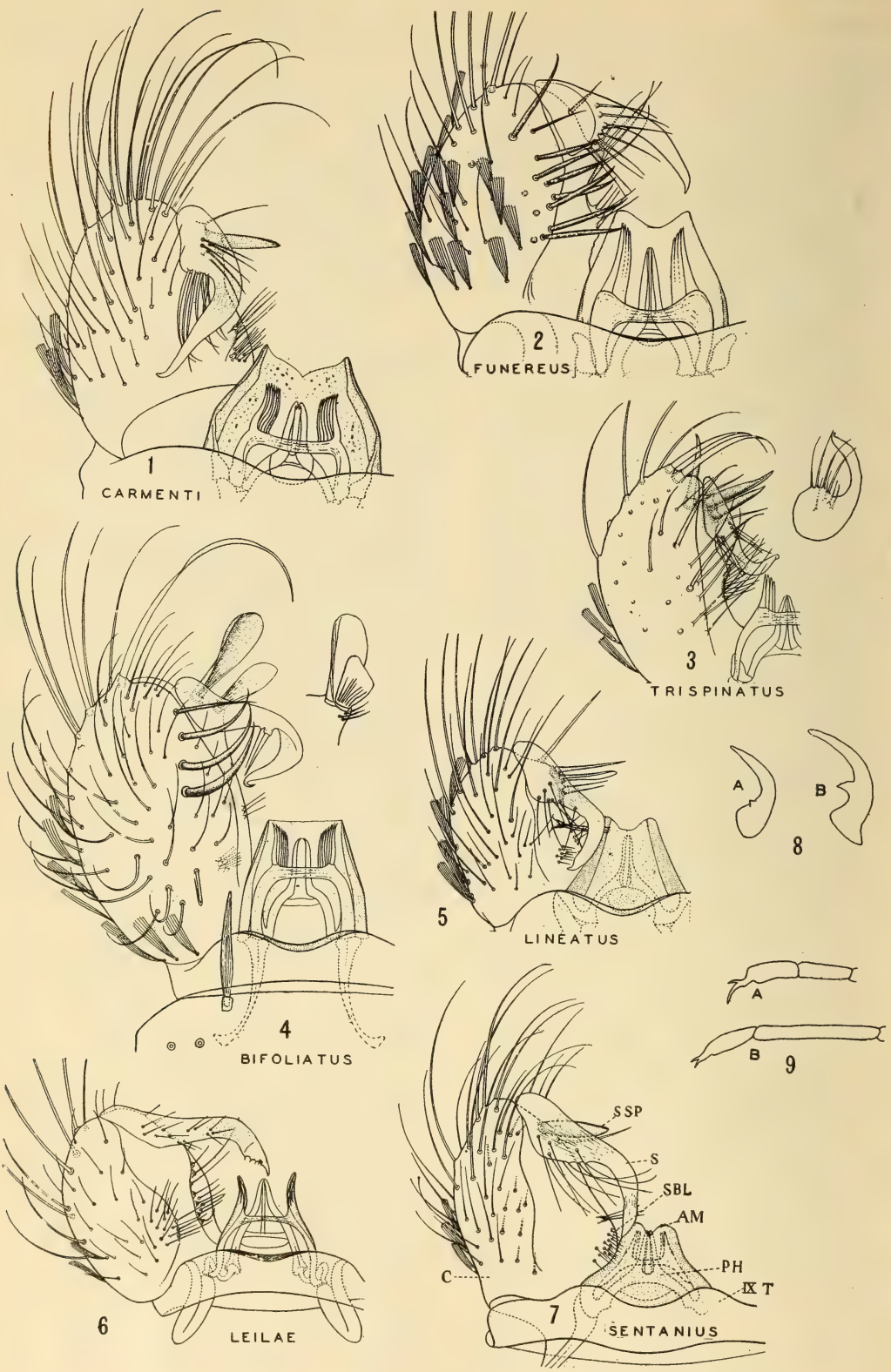
? *Aedes* (? *Skusea*) *funereus* (Theobald), Edwards, Bull. Ent. Res. **12**: 76. 1921. (Male, from Amboina, said to have a short spine at tip of side piece.)

? *Aedes* (*Aedes*) *funereus* (Theobald), Brug, Bull. Ent. Res. **23**: 79. 1932. (Figure of coxite of specimen described by Edwards.)

Aedes (*Aedes*) *ceramensis* Brug, Bull. Ent. Res. **25**: 512. 1934. (Types, 2 males from Ceram, Moluccas.) (Coxite with a stout subapical spine and otherwise similar to *carmenti*.)

The species was described as closely resembling *A. funereus* and *A. similis* except that the fore and mid tarsal claws of the female were toothed, scales on the upper sternopleuron all dark, and abdominal bands incomplete dorsally. Adult specimens obtained by the writers, and adults and larvae from the collection of Rozeboom, Knight, and Laffoon from the Hollandia area, agree well with the material from Guadalcanal.

Adults.—Head vertex with all black flat scales; *apn* bare of scales; *ppn* with scattered dark narrow scales on the upper third and a patch of fine hairs in front of bristles; scutal scales mostly dark, with a sprinkling of pale ones on front margin, over the wing roots, around antescutellar space (none on median area) and on scutellum; upper sternopleuron with a large patch of appressed translucent scales that usually appear darkish or even black, and usually in addition rather numerous small pale hairs below the scale patch and along the anterior border, with a few longer dark hairs in the anterior angle; mesepimeron with a small number of rather long pale hairs posterior to and just below the scale patch. Abdominal tergites with lateral white spots,



FIGS. 1–7.—(See opposite page for legend.)

or stripes, that extend from the base underneath toward the middle of the segments at the sides and their tips usually showing slightly from above. Fore and mid tarsal claws equal and toothed (Fig. 8B) in the female, unequal in the male with only the larger claw toothed. *Male hypopygium* (Fig. 1, Hollandia specimen): Coxite with a stout subapical spine, bluntly pointed and slightly curved, with several small bristles near its base; median lobe with about 5 bristles; basal lobe with about 8 short hairs; enlarged basal portion of style with a group of about 6 rather stout bristles on the inner side, another distinct group of 4 or 5 more slender bristles on the upper side; arm of style strongly curved near base, tapered and ending in a sharp, bent tip.

Larva.—Antennal hair 4-branched; head hair B, 3-branched, C, 5- or 6-branched; comb of about 14 scales, each rounded and fringed; airtube (Fig. 19) long, index nearly 3.0; pecten with about fourteen spines, the distal two longer and more widely spaced, the others with a single lateral tooth at basal third or fourth; tuft 2- or 3-branched; dorsal subcaudal hair of anal segment with three branches, one very long (two-thirds as long as the ventral hair), the other two short.

Remarks.—Besides the large teeth on the tarsal claws, the hairiness of the *ppn* and sternopleuron, and the pale scales around the antescutellar space are distinct aids in identification. The larva is very similar to that of *funereus* but may differ in having only a single tooth on the pecten spines instead of one large and several small basal teeth.

A. carmenti is common in the Solomons, and the Museum collection contains numerous specimens from Guadalcanal, Bougainville, and New Georgia Islands. From New Guinea there is a large series from Nadzab, Markham River Valley, eastern New Guinea, and the species was common at Hollandia. The larvae were not often found, however, and only two males were recorded from our light-traps.

Aedes (Aedes) funereus (Theobald)

Skusea funerea Theobald, Monograph of the Culicidae **3**: 292. 1903. [Type female, Queensland, Australia (probably Deception Bay, near Brisbane).]

Pseudoskusea basalis Taylor, Ann. Rept. Con. Publ. Health, Queensland, App. 6: 21 1912. (quoted from Edwards, Bull. Ent. Res. **14**: 388. 1924).

Aedes (Aedes) funereus (Theobald), Lee, Atlas Mosq. Larv. Aust. Region: 76. 1944 (illustration of larva from Cairns, Australia).

Adults.—Head vertex all dark scaled; scutal extegument and scales very dark; *apn* normally bare of scales; *ppn* with narrow scales on upper third; mesepimeron with 6–8 hairs around the lower posterior corner of scale patch; claws of fore and mid tarsi of male unequal, simple, of female equal, each with a minute tooth. Abdomen with a median and lateral white spot on tergite II, complete transverse bands on III–VI, and lateral spots on VII, the bands usually touching the base at middle and sides but curved slightly away in between producing a scalloped effect, sometimes slightly removed for entire width of segment. *Hypopygium* (Fig. 2, from one of several males from Brisbane, Australia, P. L. Douglas, collector; genitalia not previously described): coxite with a median dorsal patch of about 10 stout spinelike bristles; inner margin of lower fold with a single rather stout subapical bristle (below base of style), a median group of 6–8 bristles set in prominent tubercles, and a small basal lobe with 4 or 5 fine hairs. Style of about the usual shape in this group, with a few hairs toward the apex of the enlarged basal portion. The group of stout bristles on the coxite is distinctive among the known species of this region. A slide mount of female genitalia (specimen from Cairns) shows a short, emarginate postgenital plate.

In the larva of *funereus* as described by Lee (1944), head hair B is 3-branched, the middle branch being longer and stouter than the side branches; hair C, 6-branched; comb of 8th

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FIGS. 1–7.—Male genitalia of *Aedes:* 1, *carmenti;* 2, *funereus;* 3, *trispinatus;* 4, *bifoliatus;* 5, *lineatus;* 6, *leilae;* 7, *sentanius* (SSP subapical spine, S style, SBL subbasal lobe, AM anal membrane, Ph phallosome, IXT ninth tergite).

FIG. 8.—Claws of fore tarsus: 8A, Minute tooth in female of *parasimilis* series; 8B, female of *carmenti.*

FIG. 9.—Segments 4 and 5 of male fore tarsus: 9A, *parasimilis* series Type A; 9B, *parasimilis* series, Type B.

segment of about 14 rounded and fringed scales in a curved row; siphon rather long, index about 3.5; pecten with the distal three teeth widely spaced, long and simple, the others with a stout subbasal denticle and some smaller teeth; tuft placed beyond last pecten spine at about the apical fourth, with three branches; dorsal subcaudal hair of anal segment with three unequal branches; precratal tufts at most two.

Remarks.—Although this species has been reported rather widely from the Australasian Region, due in part to the misidentification of Amboina specimens (see under *carmenti*) by Edwards and Brug, authentic records of its occurrence outside of Australia are few. In the collections of the U. S. National Museum there are three males and one female of this species from Watutu Point, Goodenough Island, Papua, VII-17-43, B. E. Rees (of which the genitalia of one male was checked), two slide mounts of male genitalia labeled Milne Bay, New Guinea, T. K. Ruebush, and one male (of which the tip of the abdomen is missing) and one female, labeled Ladova, N. G., 10-30-43, T. K. Ruebush No. 58B. The latter locality is in the Milne Bay area. No specimens of the species were taken by the writers in the Hollandia or Oro Bay areas. Female specimens from Nadzab and Finschhafen, identified as this species, are described herein as *A. foliformis*. *A. funereus* has been reported by recent collectors from the Solomon Islands but none was found by the senior author among considerable material of this subgenus in the Museum collections. The form identified from there as *funereus* was found to be another new species, which will be described by others.

Aedes (Aedes) lineatus (Taylor)

Skusea funerea var. *ornatus* Theobald, Ann. Mus. Nat. Hung. **3**: 79. 1905 (not *Culex ornatus* Meigen, 1818 = *A.* (*Finlaya*) *geniculatus* Oliver 1791; syn. by Edwards, Bull. Ent. Res. **12**: 319. 1921). (Female types from Sattelberg, Huon Gulf, and Friedrich-Wilhelmshafen, New Guinea.)

Lepidotomyia lineatus Taylor, Trans. Ent. Soc. London, 1914 (pt. 1): 191. (Female types from Lakekamu Gold Field and Mekeo District, Papua.)

Aedes (? *Skusea*) *funereus* var. *ornatus* (Theobald), Edwards, Bull. Ent. Res. **12**: 76. 1921. (Male and female from Ceram, the male hypopygium said to be identical with *funereus* from Amboina.)

Aedes (*Aedes*) *funereus ornatus* (Theobald), Lee, Atlas Mosq. Larv. Aust. Region: 77. 1944. (Description of larva from Milne Bay, Papua.)

Taylor's name *lineatus* is available for this species, which has become well known under the preoccupied name of *ornatus*. It is one of the commonest and most widely distributed species of the subgenus, having been recorded from New Hebrides, the Solomons, New Britain, New Guinea and adjacent islands, and Ceram. It is frequently an annoying daytime pest in and near woods.

Adults.—Head with median and lateral stripes of broad yellowish scales, narrow pale scales in the angle between the eyes and a thin line part way around the eye margin; *apn* covered with narrow-curved yellowish scales in the female (often a few broad ones lower down) and with broad white scales in the male; *ppn*, with narrow dark scales on the upper part (more extensive in female) and usually a few broad pale ones posteriorly. Scutum usually with distinct or fairly distinct median and lateral stripes of yellowish or golden scales. The median stripe extending onto the antescutellar space, the lateral ones curved around the posterior margins of the fossae; a patch of golden scales over the wing root and similar scales on scutellum; pleural bristles mostly pale yellowish; scale patches large, white; mesepimeron with a few hairs posterior to and just below the scale patch; tarsal claws apparently simple in both sexes (not mounted); abdominal tergites with complete pale bands somewhat variable in position but usually about median, curving forward toward base in the middle, often incomplete on part of the segments in the male. *Hypopygium* (Fig. 5; Hollandia specimen): Coxite with a narrow subapical leaflet, often partly furled and appearing scooplike, a stout bristle arising close to base of leaflet posteriorly or dorsally, and two smaller bristles anteriorly, the posterior bristle somewhat variable in size and appearing as a short slender spine in one specimen; median lobe with three rather long bristles; basal lobe with about six short hairs; style of usual shape, the arm strongly bent, the enlarged basal portion with a slightly scattered group of about six bristles, an additional bristle at about the basal third of the arm, just before or at the bend.

Larva (Fig. 21).—Head hair B with three

branches, the middle one longer and stouter than the others; C, 4-branched, set well back of and inside B; *d* minute, *e* single, *f* 4-branched. Comb of about 10 scales in a row, rounded and fringed. Siphon comparatively short, index about 2.0; pecten of about 15 spines, the apical one or two more widely spaced, simple, the others usually with one large and one smaller basal denticle; tuft 3-branched. Dorsal subcaudal hair of anal segment with about eight subequal branches.

This species is usually easily recognized by its ornamentation. Rubbed or poorly marked female specimens might be confused with *foliformis*, in which case the best distinction is the presence of narrow scales on the *apn*. The subapical leaflet on the male coxite is somewhat similar to *parasimilis* but the external markings are distinct. The larva is characterized by a rather short airtube and subequal branches of the dorsal subcaudal hair of the anal segment. The species has little resemblance to *funereus*, of which it has previously been regarded as a subspecies.

Aedes (Aedes) panayensis Ludlow

Aedes panayensis Ludlow, Psyche **21**: 159. 1914. (48 cotypes from Iloilo, Panay, P. I.)

Aedes (*Aedes*) *panayensis* Ludlow, Laffoon, Journ. Washington Acad. Sci. **36**: 242. 1946. (Designates a male lectotype and gives a full redescription of the species, with new records from Aioki Isle, Schouten Islands, Dutch New Guinea, 1944, and Point Gila, Morotai, Moluccas, 1945.)

Adults (Schouten Islands specimens).—Head in both sexes with a few broad white scales on mid line and eye margin, sometimes a few narrow scales also on midline; *apn* with some flat pale scales; scutum with rather coarse yellowish scales forming a border in front and laterally and extending onto upper half of *ppn*, similar scales above wing roots, around antescutellar space, and on scutellum with a sprinkling of finer pale scales on dorsum. Upper sternopleuron with white semiraised scales; hairs on lower mesepimeron rather coarse, extending more than half way from scale patch to lower border posteriorly. Claws of fore and mid tarsi of both sexes equal and each with a comparatively large tooth. Abdomen with lateral oblique spots on segments II–VIII, extending slightly onto dorsum. *Hypopygium* (Fig. 6 in Laffoon, 1946): Coxite with a wide flat apical extension directed mesad, minutely toothed apically on outer edge; a row of 3 stout dorsal bristles toward inner margin of coxite, an elongate stout arm basally from inner margin of lower fold, and a small submedian lobe with about 10 small bristles. Style with the basal portion elongate, bearing one stout bristle and about four smaller ones near the apex of this portion; arm long, wide, tapered to a point. Phallosome very small; paraproct short, stout, bluntly rounded. A specimen from the Philippines shows a bridge of the dorsal arms of the tenth sternite (H-shaped structure) with a short rounded posterior projection on each side. In the female genitalia the preatrial plates are hairy and united medially; the postatrial plate is apparently bare of hairs.

Larva.—Unknown.

The species was not taken by the present writers.

Aedes (Aedes) quadrifolium Brug

Aedes (*Aedes*) *quadrifolium* Brug, Bull. Ent. Res. **25**: 512. 1934. (Type male from Torpedoboot River, New Guinea; type in British Museum.)

This species was described as having the head dark, scales on upper sternopleuron and mesepimeron dark brown, a row of hairs on the mesepimeron behind the scales, continued as a patch of hairs on the lower half, scales of anterior forked vein rather broadly lingulate, abdomen dark brown, crumpled, the venter invisible, style S-shaped with four or five rather strong hairs on inner border, coxite with four leaf-like appendages near apex, a small papilla with two hairs near base and a group of fine hairs still more basally, on inner side. In the illustration of the coxite the subapical leaflets are short and flared. Dark scales on the mesepimeron are unusual and this may have been due to discoloration. The species is not represented in our material but a related species is described under the name *multifolium*.

Aedes (Aedes) similis (Theobald)

Pseudoskusea similis Theobald, Monograph of the Culicidae **5**: 189. 1910. (Type female, Kuranda, Queensland, Australia.)

Aedes (*Aedes*) *similis* (Theobald), Edwards, Bull. Ent. Res. **14**: 388. 1924. (Reported from Burpengary, Queensland and Saparoea Island, Amboina.)

The type was described as having pale scales

(in some lights) in the middle of the head and around the eye margins, dull brown scales on the thorax with pale dull golden areas in front, over the wing roots and before the scutellum, the latter with narrow dull golden and brown scales, the abdomen with median lateral white spots above, which arise from more lateral basal white spots, the ungues all simple. Edwards (1924) stated that the scales on the upper sternopleuron were all white.

Additional notes on the species have kindly been furnished by Dr. Kenneth L. Knight from a recent examination of the type female in the British Museum. His notes may be excerpted as follows: vertex with some narrow white scales along eyes medially, some broad pale scales along nape, extending forward a ways on mid line; scutal integument dull reddish brown, scales bronzy, anterior margin of scutum with rather broad band of narrow ochreous scales; about 12 hairs on the posterior margin of the mesepimeral scale patch, one of which arises from the ventral margin; lateral spots of tergites visible dorsally on margin of II–VII, extending nearly a third the width of the dorsum, subbasally, on V–VII.

A pest mosquito commonly encountered in woods in southeastern New Guinea during the war agreed fairly well with Theobald's description (with the exception of pale scales on the head vertex) and was usually identified as *similis*. Larvae obtained by rearing from eggs laid by females collected at Milne Bay were described under this name by Lee (1944). Inquiries made by the senior author among Australian workers in 1944 and 1945, however, disclosed the fact that neither the male nor the larva of *similis* was definitely known. A sketch of the male genitalia of a specimen, possibly of this species, taken at Camp Mountain, near Brisbane, has kindly been sent us by Miss E. Marks. This shows a strong subapical spine on the coxite, very similar to that found in *carmenti*, and the hairs on the base of the style also appear similar, but the arm of the style is bent at nearly a right angle at the apical third instead of merely curved. The larva was said to be like *A. funereus* except for a longer siphon (index of 3.5 to 4.0 compared with 2.7) fewer comb scales (14–15 instead of 18–22) and a single large tooth on the pecten spines (instead of a large and several small side teeth). The female was said to be very dark, with rather small basal lateral spots on the abdominal segments, and the claws simple. Until *similis* is more definitely defined it is impossible to determine whether it occurs in New Guinea. Edward's record (1924) from Amboina is a very doubtful one. The *similis*-like forms found in New Guinea are discussed under *parasimilis*, n. sp.

Aedes (Aedes) bifoliatus, n. sp.

Male.—Scales on vertex all dark; *apn* and *ppn* without scales, the latter with a few hairs in front of posterior bristles; scales on upper sternopleuron pale, translucent; mesepimeron with a few hairs just posterior to the lower part of scale patch; wing 2.2 mm, 1st fork cell about one and a half times as long as its stem, the lateral vein scales rather short and broad; fore and mid tarsal claws unequal, simple; segments 4 and 5 short, of equal length; abdomen with narrow transverse white bands on segments III to V, not basal, incomplete ones on VI and VII, segment II all dark above (in the Milne Bay paratype, segment III has a median basal spot only, complete bands on IV–VII, almost entirely basal). *Hypopygium* (Fig. 4): Coxite with two broadened leaflets, either flared and crinkled or somewhat spoonshaped, the distal one longer than the other, which is usually nearly as wide as long; toward inner margin of dorsum a row of three to five (usually four) spinelike curved bristles; a very stout hair at apex and several a little smaller on the outer margin; median lobe with two or three short bristles; basal lobe with about ten small fine hairs. Style strongly curved, the tip small and hooked, only three or four bristles about midway of the inner side (none on base), one rather stout and set in a prominent tubercle. Eighth sternite with a stout rod-like seta from the posterior margin on each side.

Female and larva.—Unknown.

Holotype.—Male, taken by the authors in a light-trap collection at Hollandia, May 18, 1945. Deposited in the U. S. National Museum.

Paratypes.—9 males, as follows: 8 from light-trap collections at Hollandia on January 18, 19, and 24, March 25, April 3 and 7, and May 5 and 6; male from Milne Bay, New Guinea, April 11, 1944, H. R. Roberts, No. 136 (slide 46, VII.24a).

Aedes (Aedes) foliformis, n. sp.

Male.—Scales of vertex apparently all dark on holotype (head shrunken) but two of paratypes with a median stripe of broad pale scales; upright scales on nape pale brown; scaling of *apn* and *ppn* not discernible; scutum dark, a sprinkling of golden scales around margins; pleura very dark; scales on upper sternopleuron pale; mesepimeron with a few hairs posterior to and just below the scale patch; wing 2.2 mm; first fork cell about equal its stem, the lateral vein scales moderately broad; fore and mid tarsal claws unequal, simple, segments 4 and 5 equal, short; abdominal tergites with wide transverse bands on segments II to VII, basal on II and III, subbasal on IV and V, submedian or median on VI and VII. *Hypopygium* (Fig. 15): Coxite with three comparatively long narrow subapical leaflets, (or two leaflets and a pointed spine), the two proximal ones somewhat spoonshaped, crinkled or striated, the tips broadly rounded but with a short point, the distal leaflet narrower and more pointed, or reduced to a pointed spine or heavy bristle; a rather stout bristle just beyond the group and a smaller one just before (basad); dorsum of coxite with two or three fairly heavy hairs and sparse slender ones; median lobe with two bristles; basal lobe with about five small hairs; style curved, with eight or nine scattered hairs from the moderately enlarged base.

Female.—Head with a median white stripe, consisting of a double row of broad white scales along posterior half or two-thirds of midline, sometimes spreading out a little on nape or with a few narrow pale scales in front of the stripe and in the angle between the eyes. *apn* bare of scales; *ppn* with narrow dark scales on upper third, and five posterior bristles. Scutum dark, with fine dark scales, a sprinkling of whitish or golden scales around the margins and sometimes faint indications of median and submedian lines; scutellar scales pale yellowish or golden. Upper scale patch on sternopleuron with about two-thirds of the scales pale, the lower third dark, no hairs along anterior margin of this sclerite; mesepimeron with a few hairs around the lower posterior corner of the scale patch. First fork cell a little longer than its stem, the lateral vein scales long and moderately broadened. Claws of fore and mid tarsi each with a minute tooth (hardly visible unless mounted). Tergites II–VII with transverse white bands very similar to those in *lineatus*, usually about midway of the segments on VI and VII, curving forward in middle on the other segments and touching the base at the midline on II and III, also curving back to base underneath (the bands fairly close to the base for the entire width of the segment in a few specimens). In the genitalia, the postgenital plate is about as broad as long, with a shallow emargination.

The females are not definitely associated with the males but they are from the same locality and the markings are very similar in so far as can be determined from the rather poor condition of the males.

Larva.—Unknown.

Holotype.—Male, New Guinea, APO 322, IV-27-1944, E. S. Ross No. 50, with genitalia slide, 45-V-46 (Gusika, Finschhafen area, eastern New Guinea; no collection data), from the collection of the U. S. National Museum.

Paratypes.—3 males, 26 females as follows: 1 male from a light trap, Hollandia, Netherlands, New Guinea, December 4, 1944 (by the authors); 2 males, same lot as holotype; 15 females from same locality as holotype, Ross lots Nos. 29, 42, 44, 46 and 49, April and May 1944; 7 females, APO 713-1, New Guinea, August, 8-9, 1944, K. V. Krombein; 4 females same locality, Krombein lots 18 and 30, May 1944 (Nadzab on Markham River, eastern New Guinea). A few additional specimens (3 from Nadzab and 6 from Gusika) are not included as they are in poor condition.

Aedes (Aedes) leilae, n. sp.

Male.—Head vertex all dark; *apn* and *ppn* bare of scales, a few hairs in front of the bristles on *ppn;* scales of scutum and scutellum all dark; upper sternopleuron with only a few remaining scales, pale translucent, rather numerous minute hairs along anterior border; mesepimeron with a fairly large patch of hairs on posterior half extending more than half way from scale patch to lower border; wing 2.2 mm; first fork cell about equal its stem, the lateral vein scales rather short and broad; fore and mid tarsal claws unequal, simple. Abdomen with complete basal bands on segments III–VI, wide except in middle on III, apparently entirely basal (a stripe of bare in-

tegument between the bands and base of segment but no dark scales), segment II all dark above, scaling on base of segment VII indefinite, possibly an incomplete band. *Hypopygium* (Fig. 6): Coxite simple, without subapical processes or modified dorsal hairs; median area of lower fold with one strong bristle and two or three smaller ones; basal lobe with about 8 small hairs; dorsum with scattered small bristles, more numerous toward inner side at basal third. Style broad for most of its length, bent beyond middle, tapered at apex with four or five minute papillated hairs on inner side subapically; 12–15 small hairs scattered along dorsal and inner sides of style from extreme base to a little beyond the middle.

Female and larva.—Unknown.

Holotype.—Male, taken by the authors in light-trap No. 3, Hollandia, New Guinea, April 2, 1945, 500 feet elevation (with genitalia mount). Deposited in U. S. National Museum.

Paratypes.—6 males from light-trap collections at Hollandia, March 17 and 24, April 7 (2), April 12, and one undated, gen. No. 6 (the last four adults very moldy; genitalia of all mounted).

Aedes (Aedes) milnensis, n. sp.

This species is represented only by two slide mounts of the terminal segments of the male abdomen, the rest of the specimens having apparently been lost. The genitalia, however, are very distinct and it seems desirable to name the species as it stands.

Male.—Eighth sternite with two strong rodlike bristles arising near the posterior corner on each side, the bristles slightly swollen at basal third, the tips truncate, the longer one more than half as long as coxite. *Hypopygium* (Fig. 10): Coxite with a large dorsal patch of 15 to 20 bristles, a few rather thick, most of the others finely forked or trifid at tip; basal portion of dorsum with scattered slender normal hairs; a small sharply pointed leaflet subapically below base of style, flattened and striated basally; at apex, one very heavy blunt-pointed hair and two slightly smaller sharp-pointed ones; median lobe not visible; basal lobe with a few fine hairs. Style of about usual shape, with a pointed tip, 3 or 4 hairs in a group near apex of the enlarged basal portion.

Female and larva.—Unknown.

Holotype.—Male, represented by slide mount of terminal segments of abdomen, Milne Bay, New Guinea, T. K. Ruebush (? 1943); from the collection of the U. S. National Museum.

Paratype.—A similar slide of another specimen from same locality.

Aedes (Aedes) multifolium, n. sp.

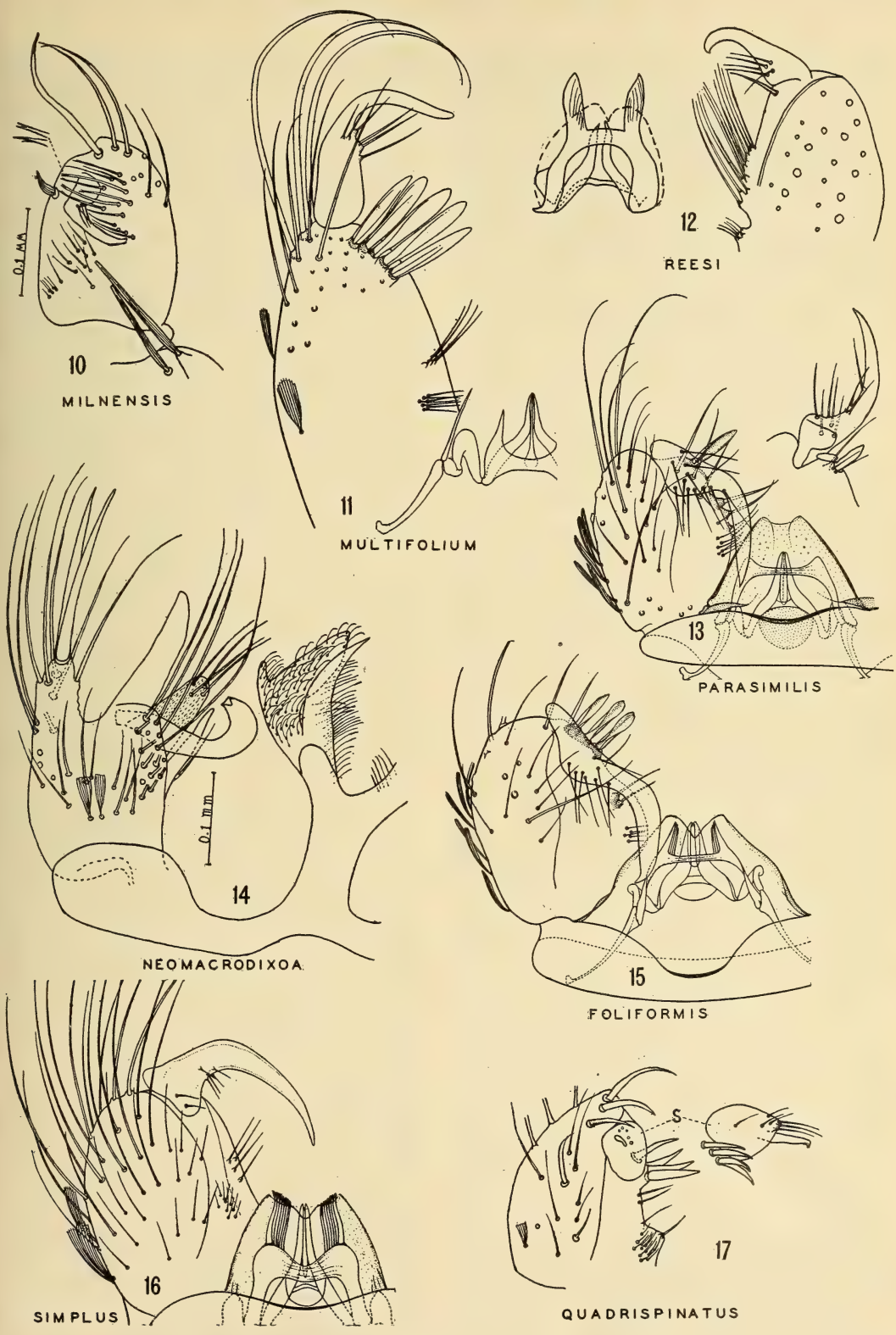
Male.—Scales of head vertex dark, a few on nape indistinctly palish; *apn* bare of scales; *ppn* with a few narrow scales on upper third and a very few hairs in front of bristles. Scutum and scutellum without pale scales (partly denuded); upper sternopleuron with appressed translucent scales and a few fine hairs toward anterior border; mesepimeron with 8 to 10 rather coarse hairs in a stripe beginning posterior to scale patch and ending about midway to lower border; wing 2 mm; first fork cell 1.7, times its stem, the lateral vein scales broadened; claws of fore and mid tarsi unequal, simple. Abdomen (partly denuded) apparently with only a median spot on segment II, complete narrow bands or indications on segments III–VI, distinctly removed from base. *Hypopygium* (Fig. 11): Subapical processes of coxite (of holotype) consist of a row of five elongate leaflets, broadly rounded at tip, the forward edge flattened bladelike, the posterior edge thicker. (In the paratype, which was badly mutilated in mounting and part of the leaflets broken off, the distal leaflet on one side appears to be replaced with a moderate bristle about as long as the leaflets, this portion being broken on the other coxite.) Apex of coxite with three very long, strong hairs; median lobe with three or four bristles; basal lobe with five or six fine hairs. Base of style unusually elongate, with five or six bristles on prominent tubercles toward apex of this portion; arm slender, strongly curved near base.

Female and larva.—Unknown.

Holotype.—Male, taken by the authors in a light trap at Hollandia, Netherlands New Guinea, January 18, 1945, with slide mount of genitalia.

Paratype.—Male, from a light trap same locality May 7, 1945. Types deposited in the U. S. National Museum.

Remarks.—The species is close to *A. quadrifolium* Brug, and the style appears identical. The holotype of *multifolium* has five instead of four subapical leaflets on the coxite, but only



FIGS. 10–17.—Male genitalia of *Aedes:* 10, *milnensis;* 11, *multifolium;* 12, *reesi:* 13, *parasimilis;* 14, *neomacrodixoa;* 15, *foliformis;* 16, *simplus;* 17, *quadrispinatus.*

four leaflets and a bristle may have been present in the paratype. From Brug's illustration and brief description, other distinctions may be noted as follows: leaflets of *multifolium* elongate and bladelike, instead of short and flared; dorsum of abdomen with white bands, instead of dark brown; hair patch on lower mesepimeron less extensive; scales on the mesepimeron pale, instead of dark as described by Brug.

Aedes (Aedes) neomacrodixoa, n. sp.

Male.—Head vertex with flat black scales except for a small patch of narrow pale scales on the nape; *apn* unscaled; *ppn* with narrow scales on upper portion; scutum usually with a few pale scales over wing root, sometimes on median area of antescutellar space and on scutellum; sternopleuron with appressed darkish scales on upper third, and a few hairs in the anterior angle; mesepimeron nearly covered with pale hairs below the scale patch; wing 2.5–3.0 mm, first fork cell equal its stem, the lateral vein scales long and somewhat broadened; fore and mid tarsus with one claw much larger than the other and bearing a long tooth; claws of hind tarsus equal and simple; abdominal tergites unbanded dorsally, with large oblique spots laterally. *Hypopygium* (Fig. 14): Ninth tergite with a large Y-shaped median extension, considerably longer than the coxite, each arm tapered to a slender tip, bare above but with a fringe of hairs basally on the inner ventral side and scattered hairs underneath apically, a large ventrolateral branch, densely setose, with a lobelike division on the outer side. Coxite with a long stout apical membranous arm, bluntly rounded at tip and bare of hairs; a tall, columnar apicoventral lobe outwardly bearing two very stout apical bristles (three in one specimen) and about six to eight scattered slender ones; an equally long subapicoventral lobe on the inner side, finely pilose and with scattered slender bristles; a stout, tapered rod from the lower fold near base, with a single bristle from the basal fifth; a patch of 15 to 20 bristles on the apical half of the dorsum of the coxite toward the inner margin and a small group of 4 or 5 bristles on the venter; inner margin of lower fold fringed medianly with fine hairs. Style wide, attached near apex of coxite, bare of hairs, sharply bent near apex and ending in a blunt recurved tip. H-shaped structure of tenth sternite not visible. Lateral plates of phallosome unusually long and slender.

Female.—Nape of head with a distinct patch of narrow pale scales mixed with the dark upright scales and extending forward part way on the midline, a few similar scales in the angle between the eyes; *apn* unscaled; *ppn* with scattered narrow scales on upper third, and about 6 posterior bristles; small patches of golden scales on front of scutum, over wing root, on scutellum and antescutellar space; sternopleuron with a large upper scale patch, the scales closely appressed but pale in appearance, fine pale hairs along the anterior border and in front of the bristles on the posterior border; mesepimeron with a large patch of hairs below the scale patch nearly to lower border; fore and mid tarsal claws with strong teeth; wing 2.7–3.0 mm (Hollandia specimen 3.5 mm), scales of first forked vein long, rather spatulate; abdomen with a basal lateral spot on segment II, oblique lateral stripes on III–VII extending well onto dorsum on the last three segments about midway from front to back.

Larva.—Unknown.

Holotype.—Male, taken by the authors in a light trap, Hollandia, Netherlands New Guinea May, 9, 1945 (gen. No. 1). Deposited in U. S. National Museum.

Paratypes.—20 males, 14 females as follows: 2 males from light-trap collections, Hollandia, trap No. 1, May 16, 1945, and trap No. 2, April 4, 1945. 250 feet elevation; 1 male (Rozeboom, Knight, and Laffoon No. 221.1), 1 female (No. 221.5), Cyclops Mountains (Hollandia area), January 1945, 1,000 feet elevation; 17 males (E. S. Ross No. 51, April 23, 1944), 13 females (No. 50, April 24), and 4 females (No. 29, April 26), New Guinea, APO 322 (Gusika, Finschhafen area, eastern New Guinea), from the collection of the U. S. National Museum. Three additional males and two females of the Gusika lots are not included as they are in poor condition.

Remarks.—This species is very distinctive among the New Guinea forms not only by reason of the genitalia but by external markings as well. It is very similar to *A. macrodixoa* Dyar and Shannon, of the Philippines, but that species lacks the narrow pale scales on the nape. As mentioned by Laffoon (1946) the male genitalia differ in having more numerous

bristles in the group on the dorsum of the coxite (15–20 vs. 8–12) and a much longer apicoventral lobe, which is columnar in shape rather than triangular and has two or three strong apical bristles compared with one or two in *macrodixoa*. The arms of the Y-shaped process of the ninth tergite of *macrodixoa* are wider and more abruptly tapered apically and the hairy branch apparently lacks a lateral lobe. A male specimen from the upper Digoel River (South New Guinea) identified by Brug (1932) as *macrodixoa* is probably *neomacrodixoa*.

Aedes (Aedes) parasimilis, n. sp.

Female (holotype).—Specimen somewhat shrunken; scales on head vertex apparently all dark; *ppn* bare of scales and hairs; five posterior bristles. Scales of scutum and scutellum all dark, fine. Upper sternopleural scales distinctly pale, no hairs visible on anterior margin; mesepimeron with four or five hairs visible around lower posterior corner of scale patch. Wing length 2.8 mm; first fork cell 1.25 times its stem, the lateral vein scales moderately widened. Fore tarsal claws (mounted) simple; segment 4 normal, a little longer than 5. Abdomen unbanded dorsally, the lateral spots rather large, their tips distinctly removed from base of tergites and visible dorsally on some of the posterior tergites.

Male.—Known with certainty only from the genitalia (Fig. 13); coxite subapically with a flattened blade-shaped leaflet, slightly pointed, a moderate bristle slightly distal to the leaflet and 2 smaller bristles set very close to base of leaflet, dorsally; a single rather stout median bristle from the lower fold and several fine hairs on basal lobe; dorsum with fairly numerous moderately long hairs on apical half, two of them rather stout. Style with eight bristles, five on the enlarged basal portion, two close together at the base of the arm and one at its middle; arm wide, flat, moderately curved, tapered apically to a small point. H-shaped structure of tenth sternite present but posterior arms not visible in mount; other parts appear about as usual.

Larva (Fig. 20).—Antenna spiculate; tuft about at middle; with four or five lightly plumose branches. Preclypeal spines long and slender. Head hair A about 10-branched; B and C each with three lightly plumose branches, the central one longer and stronger than the others, C well back of and inside of B; *d* minute, about 4-branched, well forward and inside of B; *e* single; *f* 3-branched. Mentum large, triangular, with about 18 small teeth on each side. Upper lateral hair of abdominal segment I 3-branched, lower single; lateral hair of II 2- or 3-branched, of III to VI usually single. Comb a single row of about 13 scales each rounded and fringed; pentad hair 1 much smaller than 5, with six or seven simple branches. Airtube, index about 2.5, acus present; pecten of 12–15 spines, the apical two longer and more widely spaced than the others, with one or two small side denticles; other spines with one strong and one or two small subbasal denticles; tuft 4-branched, inserted before the last spine; hair on ventral valve 3-branched. Anal segment not completely ringed by plate; lateral tuft single; dorsal subcaudal hair with 3 very unequal branches, the longest about two-thirds length of the single ventral subcaudal hair; two small tufts in front of ventral grid; anal gills moderate, equal, a little longer than saddle.

Holotype.—Female, with larval and pupal skins, Lot 634-1, 19th Medical General Laboratory, Hollandia, Netherlands New Guinea, December 22, 1944, reared from larva taken from a crayfish hole in rain forest, 250 feet elevation (W. T. Nailon, collector).

Paratypes.—A slide mount of two larval skins and the male genitalia taken from one of the two resulting pupae, which died after pupation, King Lot. No. 147, from pools at edge of swamp in Embi Lakes area, Dobodura, Papua, December 14, 1943 (W. V. King); 7 whole larvae (on slide mounts), H. R. Roberts No. 136, Milne Bay, Papua, April 11, 1944 (Faris and Gossington). The last are from the collection of the U. S. National Museum, and the other two types are deposited there.

Remarks.—This is one of the species of which females have been commonly encountered as pests in parts of New Guinea and usually identified as *similis*. It differs from *similis* in having the scales on vertex all dark and fewer hairs on the lower mesepimeron. The larva is the same as the one described by Lee (1944) from Milne Bay under this name (the paratype larval skins from Dobodura having been so identified by him). Unfortunately, we have only one female and one male terminalia (neither in the best of condition) definitely associated with this type of larva. Five unassociated male specimens at

hand have genitalic characters indistinguishable, or with only slight variations, from those of the paratype but the specimens show two types of tarsal characters that indicate specific differences in the series. One of these, type A (Fig. 9A), is represented by three specimens, one from our light-trap collections at Hollandia, 22-IV-45, one from our lot No. 459 at Hollandia, 22-XII-44, reared from a sago swamp pool, and one from lot No. 91, 40th MSU, Finschhafen, eastern New Guinea, 1944. They have segments 4 and 5 of the fore and mid tarsi of about equal length and the claws on each segment very unequal in size (as usual in the New Guinea species). The other, type B (Fig. 9B), represented by two specimens (one from our light-trap collections at Hollandia, 22-III-45, and one from H. R. Roberts lot No. 136, Milne Bay, 11-IV-45, slide No. 46-VII-28b, reared from a forest rain pool), has segment 4 of the fore and mid tarsi twice as long as segment 5, while the two claws on each foot are small and about equal in size (claws simple in both types). All segments of the legs of the type B specimens are in fact much longer than those of one measured type A specimen (light trap 22-IV-45), the total length of the fore legs of the two type B males being 7.5 and 7.0 mm., compared with 3.7 for the one type A. The Milne Bay male bears the same lot number (136) as the seven paratype larvae, thus indicating that the type B male is *parasimilis*. However, there were three other species reared in the same collection and several other kinds of larvae were found in the larval material so the association is not positive. There are also seven females from this lot that are very similar to the holotype except that the claws of the fore and mid tarsi (at least in mounts from three specimens) have minute teeth, a character that may be variable. Because of the several elements of doubt, further material will be needed to settle the identity of the males of the two types.

The Museum collection contains a rather large number of female specimens from Milne Bay, most of them (about 160 in all) from various Roberts lots taken in biting collections, which are referable to the *parasimilis* series. About a fourth of these have the scutal scales all dark while most of the others have small patches of golden scales over the wing root or on the antescutellar space, a small proportion being indefinite or with only two or three pale scales. The tarsal claws of five specimens in these lots were mounted for examination (in addition to the three in lot 136 previously mentioned). One female in lot 130 had the same combination of simple claws and all dark scutal scales as in the holotype. Two others in this lot with small patches of pale scales on the scutum also had simple claws. Of two females from lot 127, each with a few pale scales on the scutum, one had simple claws, the other minute teeth on the fore and mid claws. Of seven females from the Hollandia area (Rozeboom, Knight, and Laffoon collections), four from the Cyclops Mountains (1,000 feet) had distinct patches of pale scales on the scutum, and the mounted claws of two of these were found to be simple; three from the vicinity of Lake Sentani had the scutal scales all dark and one mounted specimen showed minute teeth. Thus in the series examined, there was a negative correlation in nine of twelve females between the occurrence of claw teeth and pale scales on the scutum; two of the others (including the holotype) had simple claws and a dark scutum while one had toothed claws and a few pale scutal scales. A study of reared series will be required to determine whether the occurrence of minute teeth (see Fig. 8A) is variable within the species.

Aedes (Aedes) quadrispinatus, n. sp.

Male.—Tori dark; head shrunken in all specimens, broad scales on nape ruffled, more or less pale, extending forward a short distance along midline in some specimens (distinct in male from Goodenough Islands), a few narrow scales sometimes visible in angle between eyes. Scutal integument with a median dark stripe or submedian dark lines, paler laterally, the scales entirely dark or with a few pale ones in front; scutellar scales dark; *apn* bare of scales; *ppn* with scattered narrow scales on upper third and a few rather long hairs in front of the lower bristles; four or five posterior bristles. Pleura dark; upper sternopleuron with a small patch of appressed translucent scales, some fine hairs along anterior border; mesepimeron with unusually coarse hairs covering most of the posterior half below the scale patch or extending well toward the lower border. Wing 2.2 mm; first fork cell about equal its stem, the lateral scales rather broad and short. Claws of fore and mid tarsi unequal, simple. Abdomen with a

small median white spot on segment II, complete narrow bands on III and IV, complete or nearly so on V and incomplete in middle on VI and VII, the bands mostly basal or slightly subbasal toward sides (complete and quite wide on III–VI in Goodenough specimen). *Hypopygium* (Fig. 17); Coxite with four heavy, bluntly pointed subapical spines below base of style, the distal one the smallest and sometimes reduced to a heavy bristle; apex of coxite extending a little beyond base of style, with three or four very heavy bristles in a row dorsally, the distal one the longest; usually one or two moderately strong hairs interspersed with six to eight slender hairs on remainder of dorsum; median lobe with two bristles; basal lobe with 10 to 14 fine hairs; style with a greatly enlarged base, ovoid in shape from above, with four or five scattered small bristles and three longer ones from distal edge; arm of style very small and slender (hardly discernible in the usual mount), bent into a right-angled beak at tip.

Female.—Abdomen with large lateral spots only, tending away from base slightly at edge of tergites, extending well onto dorsum of segment VII and often on V and VI. Claws of fore and mid tarsi with minute teeth (not visible until mounted). Wing 2.7 mm; first fork cell a little less than twice its stem. Post genital plate about as wide as long, very shallowly emarginate. One of the paratype females from Milne Bay has rather pale broad scales on the nape. In the females of Ross lot No. 27, the head is so badly shriveled that the color of the scales on the nape cannot be discerned.

Larva.—Unknown.

Holotype.—Male, New Guinea, APO 565 (Toem, Northern Netherlands, New Guinea), VIII-1-44, E. S. Ross No. 27. From the collections of U. S. National Museum.

Paratypes.—15 males, 35 females as follows: 13 males, 34 females from the same lot as the holotype (all more or less shriveled), with two slides of male genitalia and one of the female (1 additional male and 5 females from this lot, in poor condition, are not included); 1 male, Milne Bay, New Guinea IV-11-44, H. R. Roberts No. 136; 1 male, 1 female, Watutu Point, Goodenough Islands, Papua, New Guinea, VII-17-43, B. E. Rees.

Remarks.—The two specimens from Goodenough are included in the concept of this species although they differ in certain respects and perhaps represent a subspecies. Both specimens have a distinct median stripe of broad pale scales on the head, the male has a complete white band on tergite VI and the female, in which the abdomen is partly denuded, has nearly a complete line of pale scales on tergite III and indications of one on IV. The female also has more distinct pale scaling on the scutellum and the antescutellar space. The pleural characters are very similar, as also most of the genitalia, especially the unusual style. Only three typical subapical spines are present on the coxites, the fourth one being represented by a stout bristle on one side (which also occurs in one side in a Toem specimen). A female specimen from Milne Bay (H. R. Roberts No. 220, IV-11-44) is probably this species and resembles the Goodenough female in having some pale scales on the nape.

Aedes (Aedes) reesi, n. sp.

Male.—Head vertex dark scaled; *apn* and *ppn* bare of scales (the latter possibly denuded), scutum and pleura very dark; scales of scutum and scutellum all dark; scales of upper sternopleuron translucent, very indistinct; mesepimeron with a few hairs posterior to and just below the small scale patch (none discernible on holotype); first fork cell about a half longer than its stem, the lateral scales rather slender; wing length 2.2–2.5 mm; fore and mid tarsal claws unequal, simple, Abdomen with basal white bands on segments III–VII, broad on posterior segments, II and VIII all dark (none of the paratypes, which are more or less rubbed, shows complete bands). *Hypopygium:* Coxite with a single bristle subapically below base of style; dorsum with an inner and outer row of strong hairs and 6 to 8 bristles in between; submedian lobe with a patch of 12 to 20 long bristles, appearing as a prominent fringe in profile; basal lobe with about 10 fine hairs. Style with a pointed arm, moderately curved, a group of five bristles near base. (Fig. 12).

Female.—Two specimens in the same collection as the males are probably this species although differing in the abdominal banding. Thorax very dark; *ppn* with scattered dark hairs on upper third in one specimen, two or three only on other (possibly rubbed); scales of upper sternopleuron appear dark; a few hairs posterior to scale patch on mesepimeron; tarsal claws apparently all simple (not mounted); first

fork cell about twice the length of its stem on one specimen, slightly shorter on the other, the lateral vein scales quite slender; wing length 2.2 mm. Abdomen with lateral white spots only, basal below, extending somewhat obliquely and the tips showing slightly above, removed from base, on some segments.

Larva.—Unknown.

Holotype.—Male, Vivigani, Goodenough Islands, Papua, New Guinea, VII-8-43, B. E. Rees (Genitalia slide 46.VII, 26a). From the collection of the U. S. National Museum.

Paratypes.—3 males (2 with the genitalia mounted) and 2 females, same data as holotype except that one of the males is dated July 9; one additional slide mount of male genitalia, the adult for which is missing; same locality as above but dated July 10.

Aedes (Aedes) sentanius, n. sp.

Male.—Scales of head vertex all broad and dark. Scales of scutum and scutellum all narrow and dark or with a few pale ones over wing roots and on mid lobe of scutellum; *apn* bare of scales; *ppn* with a few narrow scales on upper half, and two long and two short posterior bristles; propleuron with white scales and about six bristles; scales on upper sternopleuron translucent, darkish; mesepimeron with a few pale hairs posterior to and just below the scale patch. Wing 2.5 mm; lateral scales of the forks of vein 2 slightly broadened; first fork cell about one and a half times the length of its stem. Segments 4 and 5 of fore and mid tarsi both short, subequal, the claws of each unequal, simple. Abdominal tergites with large lateral spots, extending slightly onto dorsum on segments VI and VII, either entirely basal or the more dorsal part slightly subbasal; sternites with the basal half pale scaled. *Hypopygium* (Fig. 7): Coxite with a single stout, straight subapical spine below the base of the style and a slightly longer bristle anterior to its base; median lobe with 3 close-set bristles; subbasal lobe with about 15 short hairs. Style with about 8 slender scattered bristles toward the inner side of the enlarged basal portion.

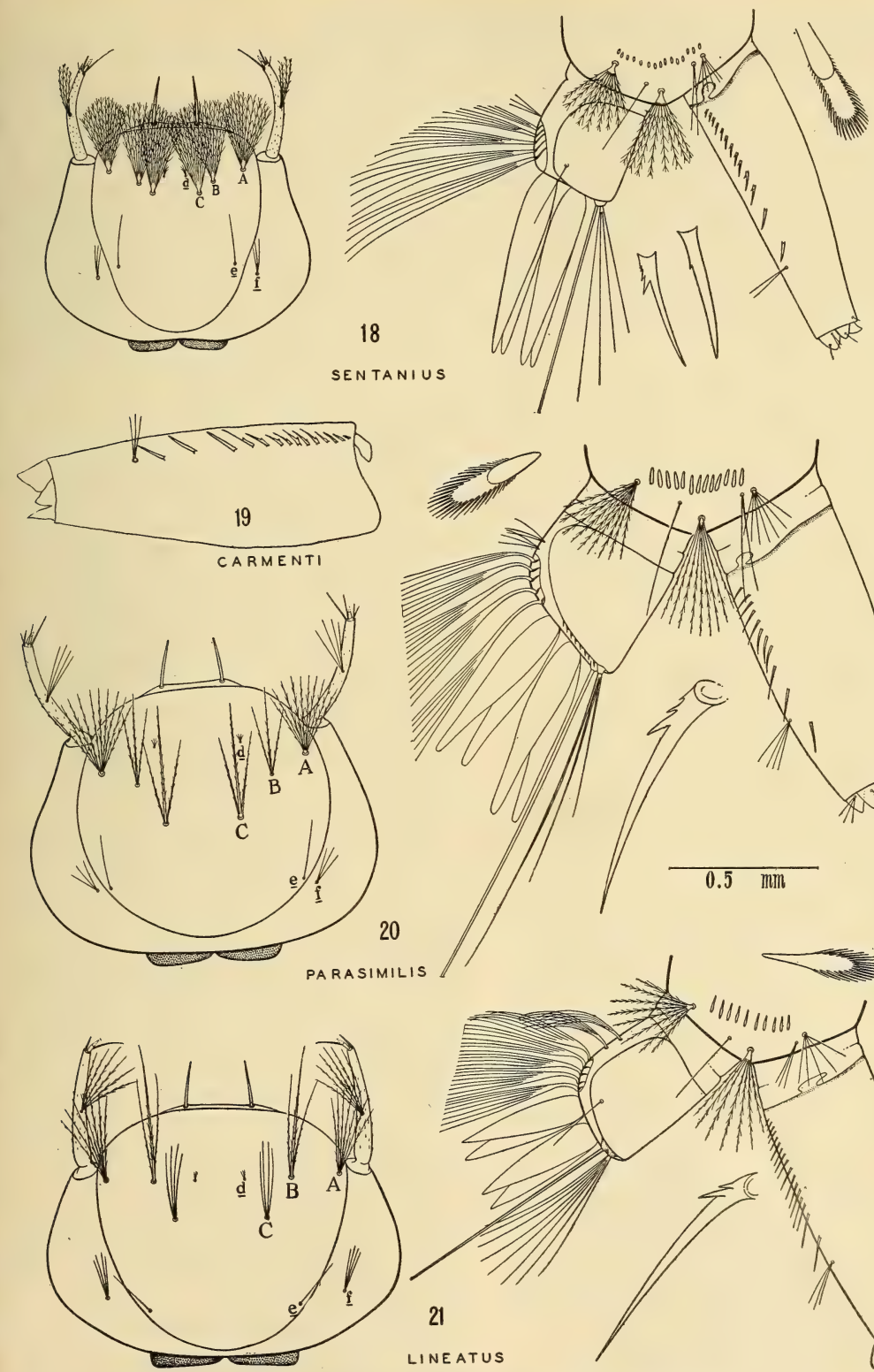
Female.—As in the male except that there are usually distinct small patches of yellowish scales on the front margin of the scutum, over the wing base, on the median area of the antescutellar space and on at least the mid lobe of the scutellum; upper fork cell about twice as long as its stem; claws of fore and mid tarsi each with a minute tooth (not visible until mounted); lateral spots of abdomen visible above only on segment VIII.

Larva (Fig. 18).—Antenna nearly half as long as clypeus, somewhat bowed, with numerous fine spicules; tuft about at middle, with three to five (usually four) lightly plumose branches; preclypeal spines long and slender; hair A with 12 to 16 branches; B with 6–10 branches; C slightly behind and inside of B, with 7–13 branches; *d* minute, about 4-branched, *e* single, *f* 3- or 4-branched. Mentum with 16 or 17 fine teeth on each side. Mesopleural tufts double, arising from a sclerotized plate with two or three small spines; metapleural tufts triple, with an additional long hair. Upper lateral hair of the 1st abdominal segment triple, the lower single; lateral hair of segment II double, of III to V usually single; comb of 12 to 16 scales in a fairly regular row, each rounded and fringed; siphon index from 2.75 to 3.50; acus present; pecten of 11 to 14 spines extending beyond middle, the apical two or three more widely spaced and either simple or with a small lateral tooth, the others shorter, with a strong subbasal tooth and one to three smaller ones; tuft beyond last spine, with two or three branches. Lateral hair of anal segment single, dorsal subcaudal hair with four or five subequal branches, less than half as long as the ventral hair; gills slender, about twice as long as saddle.

Holotype.—Male (lot 1124 19th M.G.L.), reared from larva from a hogwallow in a sago swamp at Poee Village on south side of Lake Sentani (Hollandia area), Netherlands New Guinea, June 5, 1945 (W. B. Crist and P. L. Douglas).

Paratypes.—9 males, 5 females as follows: 4 males (1043B, 1120, 1129-9, 1124) and 4 females (1043C, 1120-5, 1120-8, and 1120-10), all from the same location and from the same or similar breeding places as the holotype, April to June 1945; 2 males from light trap collections at Hollandia, April 3 and 9, 1945; 3 males (King No. 140 and 140-1), reared from shallow footprints in dense forest, Dobodura, Papua, New Guinea, December 5, 1943 (W. V. King).

Remarks.—The male genitalia of this species are very similar to those of *carmenti*, differing principally in the distribution of the bristles on the style and in the smaller number of bristles



FIGS. 18–21.—Head and terminal segments of *Aedes* larvae: 18, *sentanius;* 19, *carmenti* (siphon only); 20, *parasimilis;* 21, *lineatus.*

on the median lobe of the coxite; the adults have simple claws in the male and minute teeth on the fore and mid claws in the female (vs. large teeth in *carmenti*), and the *ppn* and sternopleuron are much less hairy. The genitalia and other characters of the adults also seem to be close to those of the Brisbane species previously mentioned as possibly being *A. similis*. The larva, however, differs from this as well as all other known Australasian larvae in having more branches in the head hairs and four or five subequal branches in the dorsal subcaudal tuft of the anal segment.

A series of 24 females in the writers' collection from Hollandia during 1945 (taken while biting), are identifiable as this species as they agree in all respects except that about half of them have from 1–3 broad pale scales in front of the bristles on the *ppn*, and one specimen has a large patch. Two females from Milne Bay (H. R. Roberts No. 203 and 218, April 1944) and two whole larvae from Hihilai, Milne Bay (Roberts No. 68, May 24, 1944) also are this species.

Aedes (Aedes) simplus, n. sp.

Male.—Head vertex dark; *apn* and *ppn* bare of scales; scales of scutum and scutellum all dark; upper sternopleuron with a few pale translucent scales, no hairs visible anteriorly; about five hairs posterior to and just below scale patch on mesepimeron; claws of fore and mid tarsi unequal, simple; wing 1.7 mm, first fork cell about equal stem, the lateral vein scales short and quite broad; markings of abdomen indistinct, small basal lateral spots visible on segments V and VI, no pale scales dorsally on these segments. *Hypopygium* (Fig. 16): Coxite unusually simple for this group, without subapical processes or modified dorsal hairs; a few short bristles medianly on lower fold, not forming a distinct median lobe; basal lobe with about seven fine hairs. Style moderately curved, tapered to a small point; two small hairs on the widened base and five at about the basal fourth. Lateral plates of phallosome a little longer and slenderer than usual; posterior extensions of the H-shaped structure of the 10th sternite with about eight filaments each (more distinctly visible than usual in this mount), separated and rather blunt at tip.

Female and larva.—Unknown.

Holotype.—Male, taken by the authors in a light trap at edge of rain forest, Hollandia area, Netherlands New Guinea, February 21, 1945. Deposited in U. S. National Museum.

Aedes (Aedes) trispinatus, n. sp.

Male.—Head missing in holotype, vertex in poor condition in the others; *apn* bare of scales, *ppn* with four posterior bristles and scattered dark hairs in front of the bristles, with a few toward the upper border; sternopleuron with the upper scales translucent, closely appressed, a few fine hairs along anterior border; mesepimeron almost entirely covered with fine pale hairs below the small scale patch; fore and mid tarsal claws unequal, simple. Abdomen with complete bands on segments II–VI (VII removed with genitalia), rather wide on IV–VI, slightly subbasal toward sides. Wing 2.2; 1st fork cell 1.5 times stem. *Hypopygium* (Fig. 3): Coxite with three strong, rather long, tapered subapical spines, the distal one smallest, and one or two slender bristles near their bases; at apex, two close-set strong curved bristles, somewhat longer than the longest spine; two or three strong hairs from dorsum; a rather prominent subbasal lobe, with 10 to 15 bristles; H-shaped structures of tenth sternite present, the posterior arms membranous, leaf-shaped; eighth sternite with the posterior row of about eight bristles considerably stronger than the preceding ones.

Female.—Head with a small triangular patch of broad pale scales on nape; *ppn* with scattered dark narrow scales on upper half; and rather numerous fine hairs in front of bristles, one also with scattered broad pale scales; scutum pale brown, the scales entirely dark. Sternopleuron and mesepimeron similar to male; tarsal claws apparently simple (not mounted); abdomen with complete white bands on segments II–V, complete or nearly complete on VI, incomplete on VII, entirely basal or slightly removed submedianly on V and VI, joined to large lateral basal spots. Wing 3 mm; 1st fork 1.5 times its stem; scales moderately spatulate.

Larva.—Unknown.

Holotype.—Male, Milne Bay, New Guinea (Papua), IV-11-44, (H. R. Roberts No. 136, gen. slide 46, VIII.4e). From collection of the U. S. National Museum.

Paratypes.—3 males, 5 females as follows: 3 males from light-trap collections by the authors at Hollandia in 1945, one on May 7 (gen.

No. 3), one April 6 (gen. No. 7; adult badly moulded), and one April 17 (gen. No. 11; adult moulded); 2 females, same lot as holotypes; 2 females (H. R. Roberts No. 203), IV-3-44, and one female (Roberts No. 127), IV-7-44, from Milne Bay. Three additional females of Roberts lot 136 are similar to the paratypes in most respects but the abdomen is not banded. One has a faint yellowish color at base of segments, the other two are partly denuded. These are possibly *quadrispinatus* but the hairs on the lower mesepimeron and on the *ppn* are more suggestive of *trispinatus*. Two of them have a triangular patch of white scales on the nape.

ADDITIONAL SPECIES

The following unnamed or unidentified forms have been examined in the Museum collection:

(1) A series of 26 females from APO 322 (Gusika, Finschhafen area, eastern New Guinea), E. S. Ross Nos. 2, 42, 44, 45, and 49, April and May 1944. These have a short median stripe of broad white scales on the head and are similar otherwise to *foliformis* except that the abdomen is unbanded dorsally, having oblique lateral spots only. The form is possibly the female of one of the species described herein, or perhaps belongs to the *parasimilis* complex.

(2) Four larval skins, J. T. Medler, Malaria Unit No. 75, New Guinea, 1944 (probably from Milne Bay), Nos. 7–27, 1, 2, 3, and 4, with pupal skins also of subnumbers 1 and 2, but the adults missing from the pin mounts. Head hair B 2-branched; C, 3- or 4-branched; siphon index 3.2; pecten of 6 to 8 very strong teeth spaced along tube nearly to apex, a few very fine fringe hairs visible at base of some of the spines; tuft 4-branched, inserted near the second spine from apex; dorsal and ventral subcaudal hairs of anal segment each single, very long; gills very long, slender, from 1.5 to 2 times as long as siphon.

This distinctive larva is similar to two specimens from Guadalcanal (20th MSU No. 776 sub 101 and 102, J. N. Belkin; Stone sp. No. 12) from which adults were reared and which will be described by others.

(3) Four whole larvae, H. R. Roberts No. 136, Milne Bay, April 11, 1944. Head hairs B and C each 2-branched; comb of about 16 elongate scales, rounded and fringed; siphon index about 2.5; pecten of about 10 spines on basal half, the apical one more widely spaced, the others with a single, very large basal denticle; tuft 3-branched, well beyond last spine; dorsal subcaudal hair with three subequal branches, less than half as long as the ventral subcaudal hair.

Of ten other larvae examined from this lot, seven were *parasimilis*, two were possibly *carmenti* and one differed slightly from *lineatus*. Four different species were represented by four males reared from this lot (*bifoliatus*, *parasimilis* type B, *trispinatus*, and *quadrispinatus*). Seven of the reared females belonged to the *parasimilis* series, two were *trispinatus* and two were near *trispinatus*. It is very unfortunate that there were no definite associations of the larvae with the adults of this interesting lot.

KEY TO ADULTS

Because of the limited number and poor condition of specimens in a part of the species, certain of the external characters employed in this key are provisional. Some caution in using the key is recommended, therefore, particularly with respect to the extent of white scaling on tergites II and VII.

1. Abdomen with complete transverse white bands 2
   Abdomen with lateral white spots or oblique stripes only 10
2. Scutum with median and lateral stripes of yellowish or golden scales; head with a median stripe of broad white scales and narrow pale scales along eye margin; *apn* covered with narrow yellowish scales in female, broad white scales in male; abdominal bands about midway of segments at sides, curving toward base in middle . . . . . *lineatus* (Taylor)
   Scutum without distinct ornamentation; *apn* bare of scales or with only occasional broad ones 3
3. Mesepimeron largely covered with hairs below the scale patch or at least extending more than halfway from scale patch to lower border posteriorly; abdominal bands basal or nearly so 4
   Mesepimeron with only a few hairs posterior to and just below the scale patch, sometimes extending a short distance below (less than halfway to lower border) 6
4. Tergite II dark or with a median white spot not joined to lateral spot, bands on VI and VII sometimes incomplete; hairs on mesepimeron comparatively coarse and dark . . 5
   Complete bands on tergites 2–6; mesepimeral hairs fine, pale, very numerous; females at

least with a triangular patch of broad white scales on nape.....*trispinatus*, n. sp.

5. Tergite II with a median white spot; band incomplete on tergites VI and VII; head with pale broad scales on nape (? always); upper *ppn* with scattered dark scales.....male of *quadrispinatus* n. sp.

Tergite II entirely dark above; VI with a complete band (VII ?); head vertex all dark; *ppn* bare of scales (female unknown).....*leilae*, n. sp.

6. Abdominal tergite II (usually VII also) without a transverse band.....7

Tergite 2 and 7 with complete transverse white bands, median or submedian on at least VI and VII; head with a median strip of broad pale scales in female, probably also in male.....*foliformis*, n. sp.

7. Abdominal bands mostly basal or only slightly removed.....8

Abdominal bands distinctly removed from base; tergite II with a median white spot; sternopleuron with a few fine hairs anteriorly; upper *ppn* with scattered dark scales (female unknown).*multifolium*, n. sp.

8. Tergite II with median and lateral white spots above; band incomplete on VII.....*funereus* (Theobald)

Tergite II entirely dark above.....9

9. Tergite VI with a complete band.....male of *reesi*, n. sp.

Tergite VI with band incomplete (female unknown).....*bifoliatus*, n. sp.

10. A large patch of hairs on lower mesepimeron, extending more than halfway from scale patch to lower border.....11

Only a few hairs below the mesepimeral scale patch posteriorly, or not extending below middle of lower half.....14

11. Head with narrow pale scales on nape or broad pale ones on midline; claws of fore and mid tarsi with large teeth.....12

Head all dark or with broad pale scales on nape; tarsal claws, if present, very small (claws not described for *quadrifolium*)...13

12. A triangular patch of narrow yellowish scales on nape; claws of fore and mid tarsi of male unequal, only the longer one toothed; apical lobe of coxite and Y-shaped extension of ninth tergite prominent.....*neomacrodixoa*, n. sp.

Head with a few broad pale scales on midline and eye margin, sometimes 2 or 3 narrow scales on midline but none on nape; claws of fore and mid tarsi of male equal and each toothed; coxite and ninth tergite not as above.....*panayensis* Ludlow

13. Head all dark (female unknown).....*quadrifolium* Brug

Broad pale scales sometimes present on nape.....female of *quadrispinatus*, n. sp.

14. A large tooth present on the claws of fore and mid tarsi of female and the larger claws of males; *ppn* with a comparatively large patch of fine pale hairs in front of the bristles (in addition to narrow dark scales on upper third).....*carmenti* Edwards

Claws of fore and mid tarsi with very small teeth or simple (all simple in male); *ppn* with very few if any hairs in front of bristles.....15

15. Head with a stripe of broad white scales on posterior half of midline.....

Unidentified females from Finschhafen area

Head scales dark on midline.....16

16. *Ppn* with scattered narrow dark scales on upper third.....17

Ppn bare of scales.....18

17. Small patches of fine golden scales on front of scutum, above wing root, on median area of antescutellar space and on scutellum; lateral scales of forks of vein 2 somewhat broadened, distinctly wider apically than at basal third.....*sentanius*, n. sp.

Scutal scales all dark; lateral scales of vein 2 linear.....female of *reesi*, n. sp.

18. Males (see key to male genitalia).....*parasimilis* series and *simplus*, n. sp.

Females (unknown in *simplus*).....19

19. Tarsal claws all simple (the validity of this character has not been fully established).....*parasimilis*, n. sp.

Claws of fore and mid tarsi each with a minute tooth (visible after mounting).....near *parasimilis*

(The female is unknown or not definitely associated in *quadrifolium*, *multifolium*, *bifoliatus*, *leilae*, *simplus* and *milnensis;* only the genitalic characters of the last species are known.)

KEY TO MALES BY THE GENITALIA

1. Ninth tergite with a large median Y-shaped extension, each arm with a large hairy branch; coxite with several processes including a subapical lobe bearing two or three heavy bristles at tip (plainly visible in unmounted terminalia).....*neomacrodixoa*, n. sp.

Ninth tergite without such an extension....2

2. Coxite with a wide flat apical extension, and a strong elongate arm from inner side of base.....*panayensis* Ludlow

Coxite without such appendages.....3

3. Coxite with two or more subapical leaflets or heavy spines below base of style.....4

Coxite with a single subapical spine or leaflet, or with none.....9

4. Coxite with two flared subapical leaflets on inner margin and a row of four or five-spine-like bristles on dorsum; 8th sternite with a heavy truncate bristle from each side of posterior margin.....*bifoliatus*, n. sp.

Coxite with more than two subapical processes; 8th sternite without modified bristles.....5

5. Three subapical processes present.....6

Four or five subapical processes present....7

6. Coxite with three heavy pointed subapical spines and a close set pair of heavy hairs at

apex; median lobe with 10–12 bristles.... ..... *trispinatus*, n. sp.

Three rounded leaflets or two leaflets and a strong bristle, subapically; no heavy apical hairs; median lobe with only two bristles.. ..... *foliformis*, n. sp.

7. Four heavy spines below base of style (the distal one sometimes reduced in size), and three very heavy bristles near apex on dorsum; arm of style very small..... ..... *quadrispinatus*, n. sp.

Four or five leaflets subapically, no heavy bristles on dorsum; base of style elongate, the arm not unusually small.....8

8. Four rather short, flared leaflets on coxite.. ..... *quadrifolium* Brug

Five (? sometimes four) comparatively long blade-like leaflets..... *multifolium*, n. sp.

9. Coxite very simple, without spines or unusual patches of bristles.....10

Coxite with a subapical spine or leaflet, or with unusual patches of bristles.....11

10. Style with a group of about five hairs at basal third, the arm curved beyond these and tapered to a point..... *simplus*, n. sp.

Style with small hairs scattered on basal two-thirds, bent at apical fourth, a few minute papillated hairs near tip.... *leilae*, n. sp.

11. A group of rather short, modified bristles on dorsum of coxite.....12

Without a distinct group of modified bristles dorsally.....13

12. Dorsal group consisting of about eight spine-like bristles, ending in a simple point; a single subapical bristle below base of style; eighth sternite without heavy truncate bristles posteriorly.... *funereus* (Theobald)

Dorsal patch of ten or more moderately strong bristles, most of which are forked at tip or have one or two minute side branches subapically; a sharply pointed leaflet, flattened basally, below base of style; a pair of elongate, stout, truncate bristles on each side of posterior margin of 8th sternite... ..... *milnensis*, n. sp.

13. Inner margin of coxite with a prominent elongate median patch of 12 to 20 long slender bristles set in prominent tubercles; subapical process represented only by a moderately strong bristle..... *reesi*, n. sp.

Median lobe and subapical process otherwise.....14

14. Subapical process a very stout bluntly pointed spine.....15

Subapical process a slender leaflet, at least flattened apically.....16

15. Style with a group of about 8 bristles on the inner side of the base, a second group of about five smaller ones on dorsal side; median lobe with about ten bristles..... ..... *carmenti* Edwards

Base of style with about 8 scattered slender bristles, not forming distinct groups; median lobe with one or two bristles..... ..... *sentanius*, n. sp.

16. Arm of style with 3 bristles, 1 near middle and 2 near its base (in addition to several on the enlarged basal portion of style); subapical leaflet short, blade-shaped, a moderate bristle distal to it... (*parasimilis* series) 17

Arm of style with a single bristle, arising near its base; leaflet longer, frequently with the edges curled, scoop-shaped, a stout bristle or slender spine distally... *lineatus* (Taylor)

17. Fore and mid tarsi with one claw distinctly larger than the other; segment 4 and 5 of about equal length.... *parasimilis* Type A

Tarsal claws equal; segment 4 of fore and mid tarsi about twice as long as 5..... Type B

KEY TO KNOWN LARVAE

1. Ventrolateral hair of siphon inserted before end of pecten.....2

Ventrolateral hair inserted beyond last pecten spine.....3

2. Anal gills normal, shorter than siphon; dorsal subcaudal hair with 3 unequal branches; pecten with 12 to 15 spines..... *parasimilis*

Anal gills very long, 1.5 to 2 times as long as siphon; dorsal subcaudal hair single, long; pecten of only 6 to 8 spines, extending nearly to apex..... species from ? Milne Bay (Medler No. 7–27)

3. Head hairs B and C each with 6 or more branches; dorsal subcaudal hair with 4–5 subequal branches..... *sentanius*

Head hair B at least with no more than 3 branches.....4

4. Dorsal subcaudal tuft of anal segment with about 8 subequal branches; siphon index usually about 2.....5

Dorsal subcaudal tuft with 3 branches; siphon index 2.5 or more.....6

5. Head hair B 3-branched, C 4-branched..... ..... *lineatus*

Head hairs B and C each 2-branched.. specimen from Milne Bay (Roberts No. 136)

6. Head hairs B and C each 2-branched, pecten spines with a single, unusually large basal denticle; branches of dorsal subcaudal hair subequal.....4 specimens from Milne Bay (Roberts No. 136)

Head hair B 3-branched, C with 5 or 6; branches of subcaudal hair unequal.....7

7. Pecten spines with a single basal denticle... ..... *carmenti*

Pecten spines with one fairly large and several smaller basal denticles..... *funereus*

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ENTOMOLOGY.—*A new species of flea of the genus* Opisodasys *from Mexico.*[1]

ROBERT TRAUB, Major, P. C., U. S. Army. (Communicated by C. F. W. MUESEBECK.)

Among the Siphonaptera I collected when serving as parasitologist with the Fourth Hoogstraal Expedition to Mexico in 1941 is a series representing an undescribed species of *Opisodasys* Jordan, 1933. It is my opinion that the structure of the aedeagus is of taxonomic importance, and hence details visible in mounted or remounted specimens are included in the description that follows. The terms used in this section, as well as most of the others, are based upon the excellent morphological studies of Snodgrass (1946).

Opisodasys hollandi, n. sp.

This species is separated from all other North American *Opisodasys* by the facts that the male eighth sternum is without bristles and has a bifid apex and that the male eighth tergum bears a prominent conical lobelike sclerotization along the caudal border.

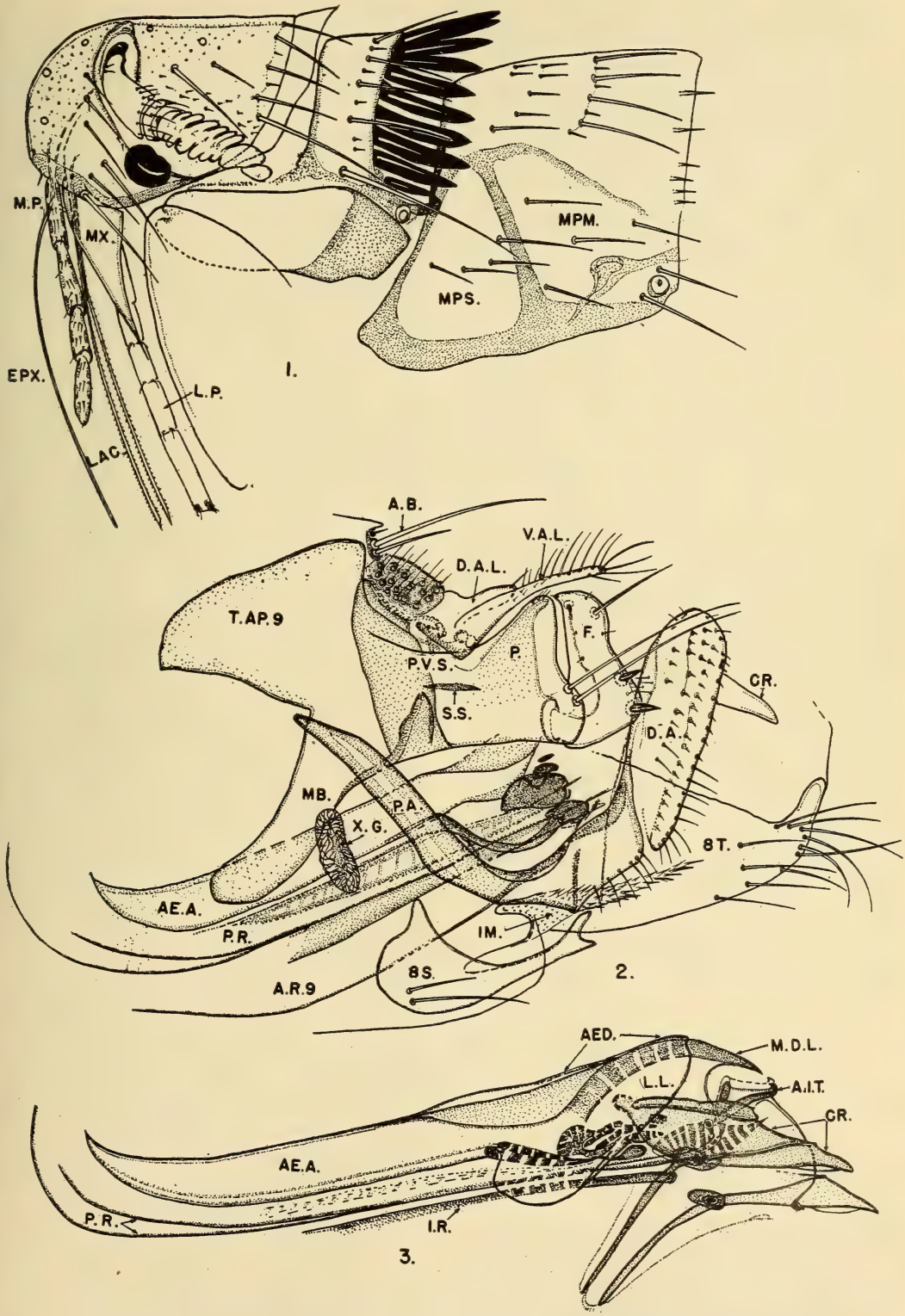
Nearest *Opisodasys perotensis* Dampf, 1942, in general structure of male claspers and ninth sternum, and in chaetotaxy and spiculose portion of eighth tergum. Distinct in that the movable finger is broader, its caudal margin more biconvex, and in possessing an apical small mesial spiniform, a long subapical marginal bristle, and two stout submarginal mesial spiniforms on proximal half, instead of three marginal mesial spiniforms (none apical) as in *O. perotensis*. Ninth sternum with several rows of spiniforms, not just with a marginal row. Female resembles *O. perotensis* in shape of spermatheca and in outline of VII sternum, but in *O. hollandi* the upper lobe of the caudal margin of the VII sternum is acute, not rounded.

The conical sclerotization along the caudal border of the male eighth tergum suggesting the sclerotized spur on the ventrocaudal angle of that of *O. pseudarctomys* (Baker, 1904).

This is a very large species, the males averaging 4 mm in length, the females 4.5 mm.

Male and female.—HEAD (Fig. 1): Clypeus (frons of authors) evenly rounded, with frontal tubercle median but slight, indistinct, arising from a small marginal sclerotization. Sparsely granular cephalad and dorsad of row of bristles. Preantennal region with one row of six bristles, with the most dorsal bristle the smallest and bordering the antennal groove; the ventralmost bristle and the preocular bristles the longest. Two or three tiny hairs bordering antennal groove cephalad of the subovate, well-developed eye. A very small bristlelike projection at ventral angle of clypeus, between the small labrum and the well-developed 4-segmented maxillary palpus (M.P.). Epipharyngeal stylet (EPX.) arising between maxillary palpi; very feebly serrate or denticulate apically. Maxillary lobe (MX.) an acute triangle, extending slightly beyond apex of third maxillary palpal segment. Maxillary laciniae (LAC.) (mandibles of authors) about one-third diameter of labial palpus; with apical two-thirds denticulate or microserrate, the serrations directed ventrad. Lacinial and epipharyngeal stylets subequal and, like the 5-segmented labial palpi (L.P.), extending slightly beyond apex of forecoxae. Scape of antenna long, subequal in length to subovate 9-segmented clavus, with two or three very small marginal hairs near insertion, and an apical row of very small bristles. Pedicel of antenna with somewhat longer bristles, but those in male extending less than one-fourth length of clavus, in female less than one-third. With a series of very small bristles in two irregular rows along dorsal margin of antennal groove. Postantennal region stippled near cephalic and dorsal margins; with a median row of two bristles and a submarginal row of five long bristles. Female with an addi-

[1] Contribution from the Division of Parasitology, Army Medical School, Washington, D. C. Received January 8, 1947.



FIGS. 1–3.—*Opisodasys hollandi*, n. sp.: 1, Head, male; 2, modified abdominal segments, male; 3, aedeagus. (See p. 139 for list of abbreviations.)

tional bristle ventrad to the ultimate very long bristle extending caudad to pronotal ctenidium.

THORAX: Pronotal ctenidium with about nine spines on each side, preceded by a row of fine bristles, and with fine hairs intercalated between the bristles. Notum of mesothorax with three rows of bristles: The first very incomplete, the second of five bristles, the third of four longer bristles; the last two with intercalated small hairs. Mesonotum with five or six bristle-like extensions near caudal margin, suggesting thin elongate spinelets. Mesepisternum (MPS.) in male with an irregular horizontal median row of four bristles, in female the bristles irregular in position. Mesepimeron (MPM.) of male with six bristles in two rows of three, the ventral two of the caudal row immediately dorsad and ventrad (though laterad) to the spiracle; the female with about nine bristles in three irregular rows of three. Metanotum with three rows of bristles, the caudal bristles four or more times the length of the others. Lateral metanotal area (supraepisternum of authors) subquadrate, with two large bristles. Metepisternum with one bristle and that near dorsocaudal angle. Metepimeron with seven bristles arranged 3-3-1, the most ventral in the second row and the most caudal bristle being about twice the size of the others.

LEGS: Mesocoxae and metacoxae with a submedian lateral longitudinal sclerotization and a mesial somewhat trident-shaped longitudinal sclerotization, the middle branch of the trident proximally joining the lateral sclerotization. Femora with one mesial bristle and no lateral bristles. Most of the dorsolateral bristles of tibiae paired. With a pair of unequal long bristles at lateroventral angle of tibae; immediately proximad a pair of very much smaller bristles. Actual measurements of male tibiae

Leg	Tibia	Tarsal segment				
		1	2	3	4	5
I.....	247	100	105	87	62	148
II.....	408	207	165	122	89	148
III.....	610	412	287	172	99	155

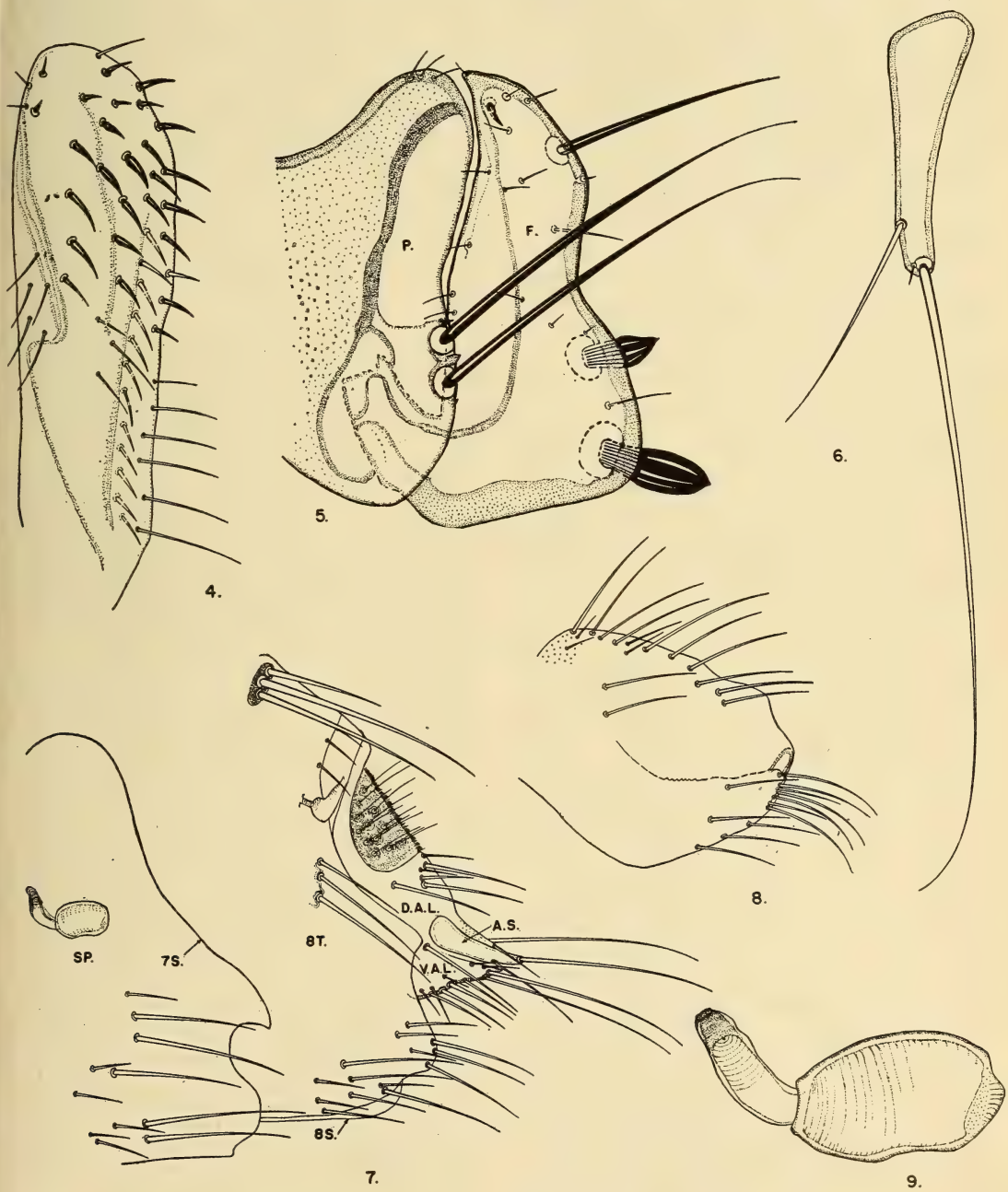
and segments of tarsi (petiolate base deleted) shown in micra. Petiolate bases of second and third protarsal and midtarsal segments long, more than one-third length of segment. None of tarsal bristles reaching beyond apex of following segment; most of the bristles not even extending three-fourths of length of following segment. Blade of unguis slightly more than twice length of thickened recurved basal portion.

ABDOMEN: Abdominal terga on each side typically with two or three short bristles in cephalic row and six long bristles in caudal row, the ventralmost bristle inserted just ventrocaudad of spiracle. In male, first tergum with two apical teeth of spinelets per side, second and third with one each; female with tergal teeth 1(2)-2-1(2)-1. Both sexes with one bristle on basal sternum and with sterna III–VI with a row of three ventral bristles. Male with three antepygidial bristles (Fig. 2, A, B.), but dorsal bristle almost vestigial, reduced to less than one-tenth length of middle bristle; ventral bristle somewhat less than half as long as middle bristle. Female with dorsal bristle somewhat more than one-half length of middle bristle, and with ventral bristle more than four-fifths length of middle one.

Modified abdominal segments.—MALE (Fig. 2): Seventh sternum truncate; with two basal bristles. Eighth sternum (8S.) reduced; basal portion with sinuate cephalic margin and a dorsad-projecting narrow lobe, dorsal margin concave; produced caudally into a narrow projection with parallel sides and with an expanded bifid apex. The X-gland (X.G.) of Wagner conspicuous near base of eighth sternum. Eighth tergum (Fig. 2, 8T., *partim*, and Fig. 8) very large, covering most of body extending caudad of pygidium; with dorsocephalic angle spiculose; dorsal margin sinuate and bearing about nine very long marginal or submarginal and two median bristles; caudal margin with a shallow sinus. Ventral third of eighth tergum more sclerotized than rest. The margin of the sclerotization curving dorsad near caudal margin and forming a prominent mesial conelike structure; ventral sclerotized portion with 9 to 13 long bristles, of which all but two or three are marginal, four or five are very long and curved ventrad, and two or three of the marginal are mesial in insertion. Ventral margin of eighth tergum concave.

Immovable process of clasper (Fig. 2, P., and Fig. 5), broad and conical, with three small apical bristles; caudal margin arching caudad in vicinity of the two long acetabular bristles, and with very small projections above, be-

tween, and below acetabular bristles. Movable finger (F.) large; with cephalic margin slightly concave and sinuate; caudal margin strongly sinuate, forming a dorsal and ventral lobe, dorsal lobe narrowing at subconical apex of finger; ventral margin straight. Finger with a mesial, relatively small spiniform near apex; with a mesially inserted long bristle near middle of caudal margin of dorsal lobe; and with two large mesial spiniforms near caudal margin of ventral lobe, the spiniforms extending distad for half or more of their lengths; with four



FIGS. 4–9.—*Opisodasys hollandi*, n. sp.: 4, Distal arm of male ninth sternum; 5, clasper lobe and movable finger; 6, anal stylet, female; 7, modified abdominal segments, female; 8, eighth tergum, male; 9, spermatheca. (See p. 139 for list of abbreviations.)

small bristles on cephalic margin; one small bristle at apex; four or five bristles near caudal margin, some mesial in insertion, and four or five small median bristles. Manubrium (MB.) wide, about three times as long as wide near base, and about one-third width of tergal apodeme of ninth tergum (T.AP.9), which forms apparent dorsoproximal portion of clasper lobe. Ninth tergum apparently reduced to a rectangular area between its apodeme and clasper lobe. Subpygidial sclerite of Wagner (S.S.) conspicuous, median, shaped like a discoid seen on end, lying parallel to longitudinal axis of body. Ninth sternum large, U-shaped, its proximal arm (vertical, anterior or interior arm of authors) (P.A.) well sclerotized, digitoid in shape. Trough of U-shaped ninth sternum somewhat wider than proximal arm, and bearing a long apodemal rod (A.R.9). Distal arm of ninth sternum (horizontal, posterior or exterior arm of authors) (D.A. and Fig. 4) slightly clavate; with a sinus at proximal fifth, forming a small proximal lobe with four or five small marginal bristles, and a conspicuous apical club armed with four irregular rows of lateral spiniforms, a row of mesial spiniforms, and scattered bristles, most marginal. Intersegmental membrane (I.M.) between eighth and ninth segments arising as a somewhat sclerotized mesial projection paralleling dorsal margin of eighth sternum, curving dorsad towards trough of the U-shaped ninth sternum, and then extending caudad as a filamentous delicate process bearing a series of threadlike tufts.

Aedeagal apodeme (AE.A., Figs. 2 and 3) elongate, with sides subparallel and with cephalic (proximal) end shortly acuminate and slightly upcurved. Base of aedeagus proper curving ventrad, concave, paralleling curve of dorsal margin of trough of ninth sternum. Aedeagus (AED. Fig. 3) much shorter than its apodeme. Lateral lobes of aedeagus (L.L.) semicircular ventrad of proximal ventral margin of base of aedeagus, then gently curved dorso-caudad, covering base of crochets and half of the acuminate, curved median dorsal lobe (M.D.L.). Armature of sheath of inner tube of aedeagus (A.I.T.) paired and bifid; with a proximal rodlike sclerotization and a distal, longer, curved, hooklike structure. The latter associated with a thin curved elliptical band which loops ventrad and apically terminates in a pair of small sicklelike blades. Aedeagal crochets (CR.) very large, extending most of length of end-chamber; subquadrate except for an elongate ventrad-directed rodlike arm; proximoventral margin convex; dorsal margin straight and heavily sclerotized; dorsodistal margin biconcave; the conspicuous boomerang-shaped part of crochets constituting the so-called parameres of authors; the caudal portion of the boomerang somewhat beakshaped. Ventral intramural rod of endophallus (I.R.) well developed. Penis rods (P.R.) not coiled, extending only slightly cephalad of aedeagal apodeme. Apodemal strut consisting of a proximal heavily sclerotized, subcordate lobe and a distal large rhomboidal lobe, associated with armature of sheath of inner tube; with smaller ovoid sclerotizations between the two.

Tenth abdominal segment conspicuous; with pygidium convex; the dorsal margin of dorsal lobe of proctiger (D.A.L.) (tenth tergum of authors) well sclerotized, although apex is relatively feeble and with small bristles. Ventral lobe of the proctiger (V.A.L.) very well developed, subrectangular, longer than the movable finger of clasper, and with submedian small bristles and a dorsal and apical row of long bristles. Proximal ventral sclerite of tenth segment (P.V.S.) (subanal sclerite of Wagner) prominent and bearing a mesial, dark sinuate sclerotization near ventrocaudal angle.

Female: Seventh sternum (Fig. 7, 7S.) with dorsocaudal margin slightly sinuate and with caudal margin shaped like an S, with a somewhat acuminate lobe formed by the roof of the S and the junction of the dorsocaudal margin; with an irregular row of large bristles. Eighth tergum (8T.) with three small bristles near spiracle; a median group of two or three large bristles, arising from a somewhat sclerotized area; ventral and ventrocaudal region with 14 bristles arranged in five irregular rows of 3, 3, 2, 3, and 3, the last three marginal. Eighth sternum (8S.) narrow, without bristles, dorsal anal lobe of proctiger (D.A.L.) with about seven bristles caudad of pygidium and a very long marginal bristle and a short marginal bristle near middle of anal stylet; with one or two long bristles ventrad of insertion of anal stylet; spiculose dorsad of stylet. Anal stylet (Fig. 7, A.S., and Fig. 6) somewhat more than three times as long as wide at base; dorsal margin concave, especially proximally, ventral

margin subparallel to dorsal; with a long ventral bristle at distal four-fifths and a very long apical bristle; at times with a supernumerary tiny ventral subapical bristle. Ventral anal lobe (V.A.L.) (tenth sternum or substylar flap of authors) well sclerotized; with caudal margin sinuate; with four stout marginal bristles at proximal portion and two very long apical bristles; with four or five small submarginal bristles near some of the larger ones. Spermatheca (Fig. 7, SP., and Fig. 8) with head roughly oblong; not quite twice as long as wide at maxima; dorsal margin slightly convex, ventral margin fairly straight but with a definite shallow sinus; margin well sclerotized. Tail of spermatheca about two-thirds as long as head and about one-third as wide; annulations apparent near apical portion; apex very densely sclerotized.

Type locality.—Mexico, state of Michoacán, vicinity of muncipality of Tancitaro, elevation 6,000–8,000 feet.

Type host.—*Sciurus poliopus cervicalis* Allen, 1890, a tree squirrel.

Types.—Holotype male; 7,800 feet elevation, July 15, 1941. Allotype female; same, July 1, 1941.

Paratypes.—Three males and 8 females; same. Four females from same host, Michoacán, Tancitaro, Mount San Miguel, elevation 6,500 feet, July 17, 1941, all collected by R. Traub.

Distribution of types.—Holotype and allotype deposited in entomological collections of Chicago Natural History Museum. Paratypes distributed among collections of U. S. National Museum, the Rocky Mountain Laboratory of the U. S. Public Health Service (Hamilton, Mont.), the British Museum; the Dominion Entomological Laboratory (Kamloops, British Columbia), and that of the author and various other siphonapterologists.

The species is named in honor of G. P. Holland, of the Dominion Entomological Laboratory, Kamloops, British Columbia, in partial recognition of his many contributions to the study of Siphonaptera.

The author is grateful to C. F. W. Muesebeck, Dr. H. E. Ewing, and Dr. R. E. Snodgrass, of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture; to Dr. William L. Jellison and Glen Kohls, of the Rocky Mountain Laboratory, U. S. Public Health Service; John Gammons, of the Division of Parasitology, Army Medical School; and to G. P. Holland, of the Dominion Entomological Laboratory (Kamloops, British Columbia) for criticizing parts of the manuscript and/or checking the status of this flea.

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ABBREVIATIONS USED IN FIGURES

A.B.	Antepygidial bristles.
AE.A.	Aedeagal apodeme.
AED.	Aedeagus.
A.I.T.	Armature of sheath of inner tube of aedeagus.
AR.9	Apodemal rod of ninth sternum.
A.S.	Anal Stylet
CR.	Crochets of aedeagus.
D.A.	Distal arm of ninth sternum.
D.A.L.	Dorsal anal lobe.
EPX.	Epipharyngeal stylet.
F.	Movable finger of clasper.
I.M.	Intersegmental membrane.
I.R.	Ventral intramural rod of endophallus.
LAC.	Laciniae or maxillary stylets.
L.L.	Lateral lobes of aedeagus.
L.P.	Labial palpi.
MB.	Manubrium.
M.D.L.	Median dorsal lobe.
M.P.	Maxillary palpi.
MPM.	Mesepimeron.
MPS.	Mesepisternum.
MX.	Maxillary lobe.
P.	Immovable process of clasper.
P.R.	Penis rods.
P.V.S.	Proximal ventral sclerite of tenth segment.
SP.	Spermatheca.
S.S.	Subpygidial sclerite of Wagner.
T.AP.9	Tergal apodeme of ninth segment.
V.A.L.	Ventral anal lobe.
X.G.	"X-gland" of Wagner.
7S.	Seventh sternum.
8S.	Eighth sternum.
8T.	Eighth tergum.

ORNITHOLOGY.—*Notes on tailorbirds* (Orthotomus) *from the Philippine Islands.*[1]

ERNST MAYR, American Museum of Natural History. (Communicated by H. G. DEIGNAN.)

A study of the Philippine tailorbirds in the United States National Museum, which H. G. Deignan made after the publication of *Birds of the Philippines* (1946), by J. Delacour and E. Mayr, posed some puzzling questions. He therefore suggested to me to revise the species *cinereiceps* and *nigriceps*, and in particular to investigate the possibility of a subspecific distinctness of the Basilan and Mindanao populations of *O. cinereiceps*, as well as the possible specific distinctness of *O. samarensis*. The ultimate results have validated Mr. Deignan's suggestions. A study of these two rare species was possible only through the courtesy of the curators of the U. S. National Museum, the Philadelphia Academy of Natural Sciences, and the Museum of Comparative Zoölogy who lent me material.

Orthotomus cinereiceps Sharpe

The type of this species was collected on Basilan (Ibis, 1877: 113). The specimen is recorded as an adult male, but chin and upper throat are white, while these parts are sooty black in a very uniform series of six adult males before me. An unsexed bird (U.S.N.M. no. 211076) also has a white chin and upper throat, but its sex can not be determined since its tail is molting. There is no difference in the coloration of males and females according to McGregor's *Manual of Philippine birds* (p. 577), but the remarks in the *Catalogue of birds of the British Museum* (**7**: 222) indicate that the type may have been a female and that females always have white on tbe upper throat. The only certain female examined by me (M.C.Z. no. 194584) has much white on the throat and only an indication of a black collar across the lower throat. The specimen, which may be partly immature, has a much shorter tail than the adult males (40 against 55–59 mm) and both wings and tail are washed with rufous. More collecting, particularly of females, is needed to establish the sequence of plumages and the amount of sexual dimorphism in this species.

Received January 21, 1947.

Three adult males from Mindanao agree in measurements fairly well with Basilan birds, but differ in coloration. They belong to an undescribed race which may be named—

Orthotomus cinereiceps obscurior, n. subsp.

Type.—U.S.N.M. no. 210841, ♂ ad., Catagan (1,100 feet), Mindanao, Philippines; May 19, 1906, Dr. E. A. Mearns.

Description.—Similar to *cinereiceps* but darker. Crown of a deeper, sootier gray. The green of the back of a deeper shade of olive; black of throat extending further down on the breast; middle of belly ashy gray, not whitish.

Wing, ♂ 48.5, 49, 50 against 47–51 (49.5) in *cinereiceps*; tail 50, 58, against 55, 55, 56, 59 mm.

Range.—Mindanao. Specimens from the type locality and from Lake Lanao (Philadelphia Academy) examined.

Orthotomus nigriceps Tweeddale

Chin, throat, and chest of adult males are entirely black, according to McGregor (*op. cit.*, p. 578). These parts are more or less mixed with white in the two female specimens examined by me. A female from Butúan, Mindanao, in the U. S. National Museum, has chin and upper throat mottled black and white, while lower throat and upper breast are black with white, droplike shaft streaks. In a distinctly immature female in the American Museum, the crown is grayish black while chin and upper throat are almost solid white. The lower throat is white with grayish edges to the feathers. The tails of both birds seem to be darker and more rufous than the back, particularly in the American Museum specimen. These specimens suggest that there is sexual dimorphism in this species and that the Butúan bird is the adult female of the species. Additional material is required to settle the question of the plumages of this species.

Orthotomus samarensis Steere

This species agrees in the coloration of its upperparts, particularly the black crown, and in the shortness of the tail so well with *nigri-*

ceps that I treated the two forms as conspecific in *Birds of the Philippines* (p. 202). However, *samarensis* is very distinct in other respects. It lacks the white superciliary of *nigriceps* and differs widely from that species in the color of the underparts, which are fairly similar in the two sympatric species *nicriceps* and *cinereiceps*. I therefore accept H. G. Deignan's suggestion to consider *Orthotomus samarensis* as a full species.

ZOOLOGY.—*Some Mexican urocoptid mollusks.*[1] PAUL BARTSCH, U. S. National Museum.

Ing. Alberto R. V. Arellano, of Mexico, D. F., has transmitted to me a small sending of land shells, which among other things contains a new species of the genus *Holospira* and extends the range of *Bostrichocentrum goldmani* Bartsch. Of this collection Sr. Arellano says that they "are from near the village of Petlalcingo, State of Puebla, very close to the border of the State of Oajaca and on the so-called 'Pan-American Highway' 309 kilometers from Mexico City. Elevations range from 1,400 to 1,500 meters. Vegetation is luxuriant cacti-mezquite, with giant cereus (much like the saguaros of Arizona and Sonora) being a prominent feature. Country-rock is Cretaceous limestone and marl and topography consists of large hills with rounded sides, the valleys being narrow. Locally the people refer to the smaller hills (100 meters relief) as 'mogotes,' which as far as I know is the only case in Mexico where this Cuban term is used."

The new species may be known as:

Holospira albertoi, n. sp.
Fig. 1

Shell cylindroconic, white, thin, translucent. The nucleus consists of about 1.5 smooth turns, the last of which is a little wider than the first postnuclear whorl. The postnuclear whorls increase very gradually in size until the middle of the spire is attained; from here on they are of equal width and render the shell cylindric. All the postnuclear turns are marked by slender, sublamellar, retractively slanting axial ribs, which are separated by spaces three to five times the width of the ribs; they extend equally strong from the summit of the whorls to the umbilicus. Suture very slightly constricted. Periphery of the last whorl well rounded. Base slightly contracted, well rounded, and narrowly openly umbilicated. Last whorl solute for about one-eighth of a turn. Aperture subcircular with a weak notch at the posterior angle. Peristome strongly reflected and thickened. Columella very slightly twisted, slender, hollow, bearing a strong fold in the penultimate whorl, which is well rounded on its free edge and which extends one-third of the way across the whorl, approximating the parietal fold a little more closely than the basal one. The parietal fold is thin

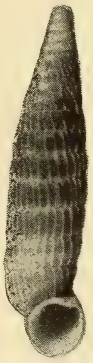


FIG. 1.—*Holospira albertoi*, n. sp.

and outward-curved and about double the width of the basal fold, which is slightly inward bent. Both the basal and parietal folds are inserted in the middle of the turns, and their free edges point toward each other, leaving a space of one-quarter of the width of the whorl between them. The lateral fold is a mere thread on the inside of the outer lip opposite the open space between the basal and parietal folds. All four folds are confined to the penultimate whorl.

The type, U.S.N.M. no. 543495, was collected by Sr. Arellano "from steep west bank of gully on southeast lower flank of Cerro Chimeco. The snails were in hardened limonitic soil developed from the underlying Cretaceous

[1] Published by permission of the Secretary of the Smithsonian Institution. Received December 17, 1946.

marl. I thought this might indicate that the snails had been dead for quite a few thousands of years, but in the vicinity what appears to be the same type of snail was found (just the shell) clinging to the underside of loose stones."

It has 15.4 whorls and measures: Length, 15.3 mm; greatest diameter, 3.7 mm. U.S.N.M. no. 543496 contains nine topotypes and some fragments from the same source. Another lot, three specimens, U.S.N.M. no. 543497, Sr. Arellano says "were collected from the east and north side of Cerro Sangre de Grado, on the southwest side of Kilometer 304 on the 'Pan-Am. Highway.' The snails were loosely lying under bushes, and the rock underneath is Cretaceous limestone; they were collected along a footpath through a distance from 500 to 1,000 meters."

Bostrichocentrum goldmani Bartsch

The type and topotypes of this species, U.S.N.M. no. 187793, were collected by Dr. E. W. Nelson at Tamazulapan, Oaxaca, Mexico, which is in the province adjacent to Puebla, not a very great distance from the present sending consisting of 30 specimens, U.S.N.M. no. 543498, which were gathered at the same place as the three U.S.N.M. no. 543497 of *Holospira albertoi* mentioned above. This is a northward extension of the previously known range of *Bostrichocentrum goldmani*.

PROCEEDINGS OF THE ACADEMY

407th Meeting of the Board of Managers

The 407th meeting of the Board of Managers held in the Cosmos Club, March 17, 1947, was called to order at 8 P.M. by the President, Dr. Waldo L. Schmitt. Others present were: H. S. Rappleye, N. R. Smith, W. N. Fenton, M. A. McCall, H. B. Collins, Jr., W. W. Diehl, F. L. Mohler, J. S. Wade, W. W. Rubey, W. A. Dayton, F. B. Silsbee, M. A. Mason, A. O. Foster, H. G. Dorsey, O. B. French, C. L. Gazin, and, by invitation, G. P. Walton, J. I. Hoffman, A. Stone, and E. A. Chapin.

The President announced the appointment of Frank Thone as the Academy's delegate to the Council of the American Association for the Advancement of Science for a period of two years.

The Chairman of the Meetings Committee, Mr. Walton, announced that the April meeting of the Academy would be held jointly with the Philosophical Society of Washington and that the speaker would be Dr. P. W. Bridgman, Nobel Prize winner.

The Chairman of the Committee on Membership, Dr. Diehl, presented 10 nominations for resident membership.

The Secretary reported the death of Edward A. Goldman, formerly of the Fish and Wildlife Service, on September 2, 1946; Howard S. Roberts, formerly with the Geophysical Laboratory, on January 20, 1947; and Admiral Charles S. Butler, formerly of Bristol, Tenn., on October 7, 1944.

The Treasurer, Mr. Rappleye, asked that he be authorized to issue proxies, as may be required, to permit shares owned by the Academy to be voted at business meetings of the various organizations in which the Academy has funds invested. The Treasurer's request was approved by the Board.

The Senior Editor, Dr. Fenton, reported that the Editors now have on hand a sufficient number of manuscripts to insure a reasonably even distribution of subject material in forthcoming issues of the Journal.

The Board authorized the President to appoint a committee to prepare a "White Book," listing the members of the Academy and the revised bylaws. F. G. Brickwedde was appointed Chairman of the committee, with the Treasurer, H. S. Rappleye, and the Secretary, G. L. Gazin.

It was proposed that the Academy take an active interest in the sponsoring of a Junior Academy of Sciences for Washington, D. C. The President was authorized to appoint a committee to look into the matter and make recommendations to the Board. The President appointed Austin H. Clark, Chairman of this committee, with Egbert H. Walker and Frank Thone.

The President was authorized to appoint a Legislative Committee to report from time to time on legislation in Congress pertaining to scientific work and development.

The meeting was adjourned at 9:10 P.M.

C. L. Gazin, *Secretary.*

Obituaries

James Hopwood Jeans was born at Southport, England, in 1877 and died on September 16, 1946. He was educated at Merchant Taylor's School and Trinity College, Cambridge; he became a fellow of Trinity in 1901. In 1905 he was appointed to a chair of applied science at Princeton, which he occupied until 1909. Soon after returning to England, he gave up formal teaching and devoted himself to research. In 1917 he was awarded the Adams Prize for the essay "Problems of Cosmogony and Stellar Dynamics," and in 1922 he received the Gold Medal of the Royal Astronomical Society. In 1906 he was elected a fellow of the Royal Society, in 1928 he was created a knight, and in 1939 he was awarded the Order of Merit. He was an honorary member of the Washington Academy of Sciences.

Jeans was a powerful applied mathematician who made fundamental advances in the theory of gases and the physics of the atom, of the photon, of quanta, and the physics of the stars and nebulae. As time went on, he became more and more interested in astronomy, cosmogony, and allied fields. His writings often reflected the philosophical aspects of science. This, combined with a fine mathematical style, banished the usual dullness of scientific discussions in these fields. In the discussions in *Astronomy and cosmogony* he differs from the work of Eddington in his ideas on the internal constitution of the stars. Some of the ideas advanced may not be entirely in phase with present developments, but his conclusion, that the stars in general have liquid cores and consist of elements of higher atomic number than 92, is probably more acceptable now than when it was published. Anyone interested in the beginnings, evolution, and endings of the various members of our universe must read Jeans' works on astronomy and cosmogony for a well-rounded picture of scientific and philosophical thought on these subjects.

James I. Hoffman.

Henry Godfrey Avers, chief mathematician, Division of Geodesy, U. S. Coast and Geodetic Survey, died at his home in Washington, D. C., during the early morning of Sunday, January 19, 1947, after an illness that had kept him away from his office for about four months.

Mr. Avers was born at Elmore, Ohio, on March 6, 1886, the son of John H. H. and Elizabeth (Nieman) Avers. He was the third of five children in the family and, with the exception of his sister Mary, who died in infancy, was the first of them to pass away. He is survived by his widow, Helen Nelson Avers; his brother, Edward J. Avers, of Elmore, Ohio; and two sisters, Emma Louise Avers and Mrs. C. H. Renner, of Monroe, Mich.

Avers attended grammar school and high school at Elmore; was a student at the Metropolitan Business College, Toledo, Ohio, 1902–03; studied at the College of Engineering, Ohio Northern University, 1906–08; and completed his formal education at George Washington University, 1909–13, graduating with an A.B. degree.

He entered the service of the U. S. Coast and Geodetic Survey in 1908 as a geodetic computer. In September 1924 he became chief mathematician, Division of Geodesy, and held at the same time the position of chief, Section of Leveling, in the same division. This arrangement continued until August 1929, when he was relieved of direct responsibility for the Section of Leveling. He continued as chief mathematician of the division until the time of his death.

During the period from 1917 to 1922, inclusive, Avers made several trips to the field as chief of party on first-order leveling operations, doing leveling of high precision in Texas, Mississippi, Alabama, Kentucky, Wisconsin, New York, and Vermont.

Avers was a member of the National Geographic Society Committee of Experts that examined the records of Commander Richard E. Byrd and determined that Byrd's plane flew very close to the North Pole in 1926 and the South Pole in 1929.

He was the author of Coast and Geodetic Survey Special Publication No. 140, *Manual of first-order leveling*, first published by the Survey in 1928 and later reprinted several times. He was coauthor of several other important Survey publications. In addition, his contributions to scientific and technical literature included papers for the American Geophysical Union, Mathematical Association of America, Fifth Pacific Science Congress, the Military Engineer, and Bulletin of the National Research Council (Physics of the Earth.)

While Mr. Avers's principal interests cen-

tered around the computation and adjustment of geodetic survey records and the publication of control-survey data, he had a wide variety of other interests, as is evidenced by his memberships in the following organizations: Mathematical Association of America; Philosophical Society of Washington; Washington Society of Engineers; Washington Academy of Sciences (treasurer, 1930 to 1939, inclusive, and member of the Board of Managers, 1946); American Association for the Advancement of Science; American Society of Civil Engineers (secretary, Division of Surveying and Mapping, since 1929); American Geophysical Union (secretary, Section of Geodesy, 1929–31, and chairman, 1932–35); American Astronomical Society; American Congress on Surveying and Mapping; National Geographic Society; Cosmos Club of Washington; Albert Pike Lodge, No. 36, F. & A.M.; Albert Pike Consistory, A.A.S.R.; and Almas Temple, A.A.O.N.M.S.; and Reformation Lutheran Church.

Avers was an ardent fisherman, a congenial companion, and a kind and considerate superior. He was particularly devoted to his wife, who nearly all her married life has been an invalid. His passing at the age of 60, has deprived his family and friends of a decade or more of his companionship, which they would normally have had every reason to expect would be theirs.

HOWARD S. RAPPLEYE.

ACADEMY AWARDS

The meeting of the WASHINGTON ACADEMY OF SCIENCES held on the evening of March 20, 1947, was devoted to the presentation of its Awards for Scientific Achievement for 1946. The Awards were presented as follows:

For the Biological Sciences to WALDO RUDOLPH WEDEL, of the U. S. National Museum, Smithsonian Institution, in recognition of his distinguished service in contributing to the knowledge of the prehistory of human ecology in the Central Great Plains;

For the Engineering Sciences to MARTIN ALEXANDER MASON, of the Beach Erosion and Shore Protection Board, War Department, in recognition of his distinguished service in erosion studies leading to successful beach invasions by Allied armed forces during the War; and

For the Physical Sciences to GEORGE WASHINGTON IRVING, JR., of the Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, in recognition of his distinguished service in biochemistry and especially for work on antibiotics in tomato plants.

The recipients each gave brief résumés of the work for which the Awards were made. Space will be devoted to these in later numbers of the JOURNAL.

ACADEMY LIFE MEMBER ESTABLISHES BOTANY FELLOWSHIP AT MINNESOTA

The Board of Regents of the University of Minnesota has accepted a gift of $15,000 to establish "The Conway MacMillan Memorial Research Fellowship in Botany, Charles J. Brand, 1902, Founder," with an annual stipend of $1,200. Mr. BRAND plans to add to the fund and hopes to interest other men and women who were trained by Professor MacMillan in making the fellowship permanent.

The founder of the fellowship is a life member of the WASHINGTON ACADEMY OF SCIENCES. He is best known for his 20 years' work in the U. S. Department of Agriculture in research, administrative, and consultative capacities, his most recent service being as coadministrator of the Agricultural Adjustment Administration in 1933. He is also well known in the trade-association field as the executive officer from 1925 to 1945 of the educational, legislative, research, statistical, and other activities of the National Fertilizer Association.

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PHYSICS.—*Exploring the fundamentals of aerodynamics.*[1]

HUGH L. DRYDEN, National Bureau of Standards.

The selection of a topic for a presidential address before such a general scientific organization as the Washington Academy of Sciences has offered some difficulty. One has the choice of attempting some broad philosophical discussion of science in relation to society, military affairs, or the Government, of setting forth the contributions of his own specialized field of science to human welfare as a means of justifying on practical grounds its claims to support by society, or of simply describing the present status and challenging problems of his specialized field in extending the frontiers of human knowledge. I have elected to follow this last plan, since I could add but little to the many excellent discussions of the broader relations of science which are found both in our own past proceedings and in the scientific press of today and since I feel that the constant harping on immediate practical applications hampers the development of basic scientific knowledge. The matters of which I will speak do have applications not only to improving the performance of aircraft, its most publicized application, but also to such diverse fields as improving the performance of power plants, improving processes such as drying, mixing, and evaporation used in the manufacture of many useful materials, improving ventilation of buildings and many others. But I prefer to uphold the somewhat old-fashioned view that advances in pure science need no justification by immediately evident practical applications. Like a program of conservation of forests, soil, or other natural resources, the practical benefits lie in the future and can not be fully foretold. For some reason our national characteristics are such as to lessen our enthusiasm for such investments.

In spite of the fact that the war has monopolized the time of all scientists and in particular physicists and aerodynamicists, there has been substantial progress in our understanding of the fundamentals of the motion of air. During the war even this type of material was classified as confidential or secret, but now, fortunately, these classifications have been removed. Some of the work described in this account was done at the National Bureau of Standards with the cooperation of the National Advisory Committee for Aeronautics. Like many scientists I find myself with the passing of years occupied more and more with administration and less and less with the active day-to-day direction of experimental work. Therefore I wish specially to emphasize that the experimental work was directed by G. B. Schubauer and carried out with the collaboration of H. K. Skramstad, P. S. Klebanoff, and W. Squire.

The student of air motion learns to recognize certain recurring typical situations in the great multiplicity of naturally occurring and experimental situations and to understand complicated phenomena as an assembly of these idealized typical situations. This procedure is nothing but the familiar scientific method of isolating certain aspects of natural phenomena, reconstructing idealized and simplified versions for experimental study, and of attempting to understand these simplified situations.

The first of these typical situations is that present near the surface of the forward portion of a body moving through the air. No matter how fast the body moves, the air

[1] Address of the retiring president of the Washington Academy of Sciences. Read by title at the meeting of the Academy on February 20, 1947. Received February 28, 1947.

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immediately in contact with the surface is at rest relative to the surface, i.e., is carried along with the speed of the body. At a considerable distance the air is at rest if there is no natural wind. It is convenient to observe the motion from the standpoint of an observer on the moving body, i.e., to consider the equivalent case of flow around a fixed object placed in a moving air stream. At speeds less than the speed of sound the presence of the object causes the oncoming air to slow up directly in front of the object and to be deflected around it. As the air moves around the object its speed increases above the free stream speed. These effects extend to distances comparable with the dimensions of the object, but their magnitudes are greatest near the body. The resulting field of flow around the forward part of the object corresponds fairly well to that predicted from the theory of a fluid without friction except in a thin film very close to the surface. Here the speed falls rapidly to zero at the surface, the rate of change with distance normal to the surface being several times greater than in the flow outside. This relatively thin layer, known as the boundary layer, was first observed by L. Prandtl, of the University of Göttingen, about 40 years ago. It is produced by the action of the viscosity of the air. Prandtl developed the mathematical theory of the flow in a boundary layer starting with the long established Navier-Stokes equations for the motion of a viscous fluid.

The thickness of the boundary layer depends on the size of the object and its speed through the fluid as well as on the viscosity of the fluid, the thickness at any point for geometrically similar bodies being proportional to the square root of viscosity times a linear dimension divided by the speed. The actual thickness for a particular case is shown in Fig. 1. Here the object is a long elliptical cylinder of about 4 inches by 12 inches cross section in an air stream of 60 and 70 feet per second. The thickness is only a few hundredths of an inch at the nose and is considerably less than 0.1 inch over the entire front portion.

Beginning about 25 years ago it has been possible to study the distribution of speed and the character of the motion within boundary layers. The instruments used are extremely small probes made of hypodermic tubing for measuring the pressures produced by the flow or extremely fine wires heated electrically whose rate of cooling is a measure of the air speed. The mechanics of the flow within the boundary layer has proved to be the key to the understanding of many aerodynamic phenomena.

It was soon discovered, first by Prandtl from indirect evidence such as skin friction

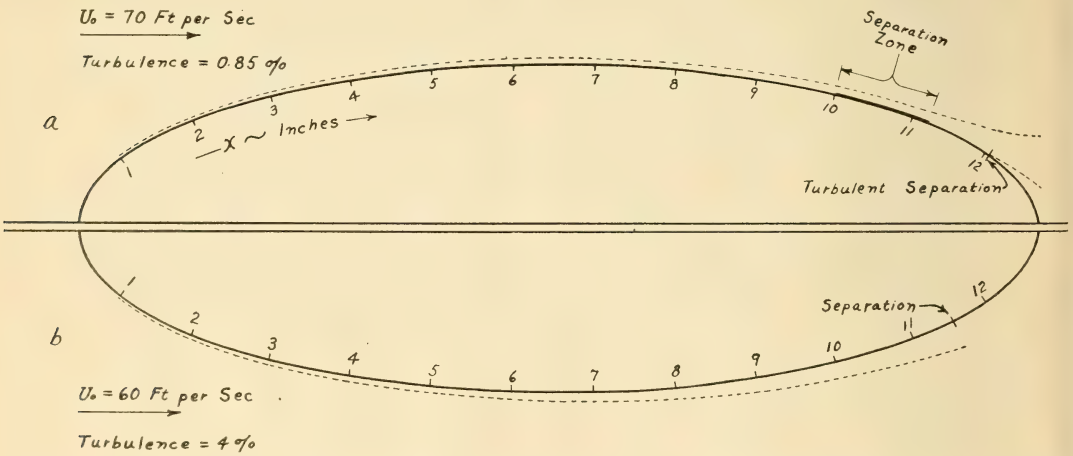


FIG. 1.—Actual dimensions of boundary layer and typical phenomena for two typical cases of flow past an elliptic cylinder: *a*, Air speed 70 ft/sec, initial turbulence of air stream 0.85 percent. Laminar separation occurs at $x = 10$ inches followed by transition to turbulence and reattachment at $x = 11.2$ inches. Separation of the turbulent layer occurs at $x = 12.1$ inches. *b*, Air speed 60 ft/sec, initial turbulence of air stream 4.0 percent. Transition to turbulence occurs at $x = 5.0$ inches and turbulent separation at $x = 11.5$ inches.

measurements and later confirmed by others by direct measurement of speed distribution, that the flow in a boundary layer does not always correspond to that described by the Navier Stokes equations, a flow that is commonly called laminar since it may be considered to occur in thin laminae that slide over each other with only the friction associated with the viscosity. The flow is often turbulent, another concept long familiar to hydraulic engineers. A precise definition of turbulent flow is somewhat technical, but as in the case of many concepts hard to define in words, every layman is familiar with the phenomena described. He has surely observed the smoke from a cigarette in a quiet room rising smoothly in layers, the motion described as laminar. At some distance above the cigarette, however, unless the air in the room is extraordinarily quiet, this smooth motion breaks up into a confused series of whirls and eddies, a motion described as turbulent. One characteristic of turbulent motion is the presence of random speed fluctuations superposed on the mean flow. The isolation of these concepts of two kinds of flow, the development of more precise descriptions, and the recognition of the two types in various parts of the flow field aided greatly in understanding more clearly what went on and why in complicated flow fields.

One striking difference in regions of laminar and turbulent flow in boundary layers is the great increase in skin friction when the flow becomes turbulent or conversely the very low skin friction which is obtained if the boundary layer flow can be maintained in the laminar state. During the war the Germans captured one of our Mustang aircraft and measured its performance. They were astounded. To quote from one of their reports: "There has been much discussion of the question of the Mustang wing. The comparison of flight measurements, however, shows quite unmistakably that the Mustang is far superior aerodynamically to all other airplanes and that it maintains this superiority in spite of its considerably greater wing area."

The Mustang wing was of the general type first developed by E. N. Jacobs and his colleagues of the National Advisory Committee for Aeronautics in the years just prior to the war, a type known as laminar flow wings. These wings are so designed as to maintain the flow in the boundary layer laminar over the greatest practicable area of the wing surface, a result accomplished as will be discussed later by designing the wing section so that the pressure on the surface continually falls from its maximum value at the nose for as great a distance from the nose as practicable. (See Fig. 2.) The resulting drag of the wing at the design lift is about one-half that of a conventional wing for which the boundary layer flow is turbulent except near the nose. The low drag region is limited to a certain range of lift coefficient as shown in Fig. 3.

The development of these wings was made possible by fundamental studies of the character of flow in the air streams produced in wind tunnels and improvements in wind-tunnel design carried out by the NACA and by the National Bureau of Standards. The low drag occurring in flight is not observed in ordinary wind tunnels, for in a wind tunnel it is difficult to eliminate completely the turbulent motion arising from the blades of the wind-tunnel fan, the guide vanes at the corners, and the wall of the wind-tunnel upstream from the model. The presence of this turbulence makes it impossible to maintain the boundary layer flow laminar for any considerable distance.

The residual turbulence in an air stream can be described in part by the root-mean-square values of the speed fluctuation. Even though the turbulent fluctuations amount to less than 1 per cent of the mean speed, they produce large effects on the boundary layer flow; in particular the transition from laminar to turbulent motion is controlled by the turbulence present. In free flight the turbulence is substantially zero. Hence there has been great interest in the effects of turbulence in wind tunnel measurements and in the reduction of turbulence in wind tunnels.

It is only recently that methods have been developed for decreasing the turbulence of an air stream. This "smoothing" of an air stream is somewhat analogous to

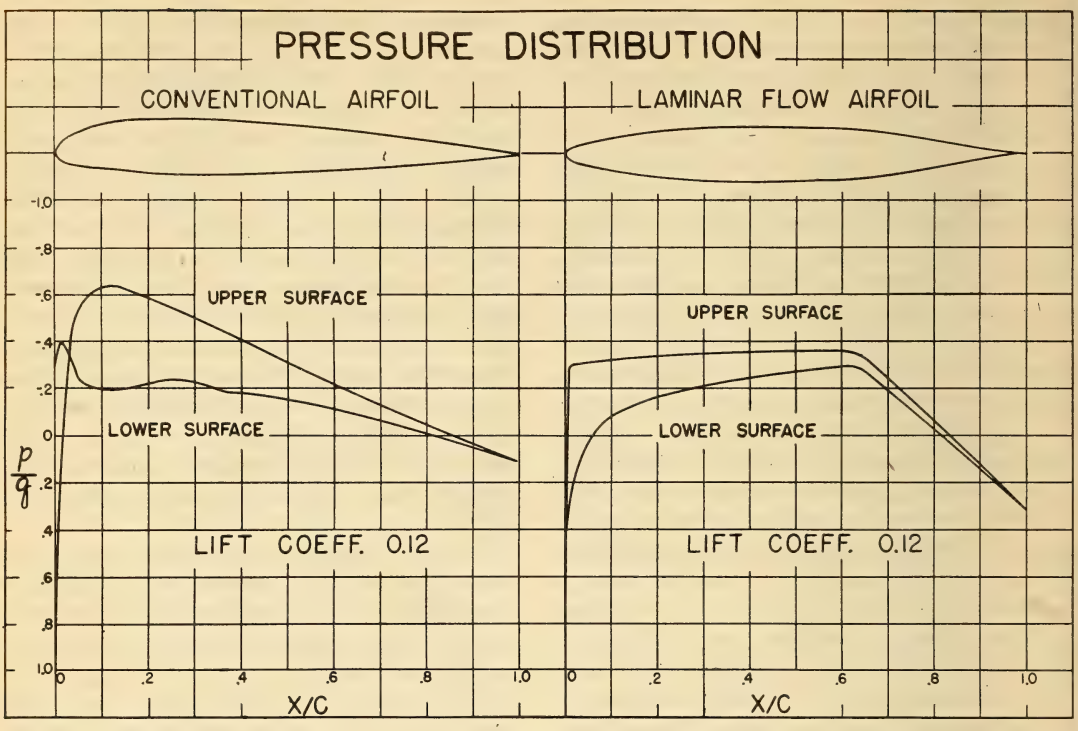


FIG. 2.—Pressure distribution on conventional and laminar flow airfoils: x = distance from leading edge, C = chord length, p = the pressure referred to the static pressure of the undisturbed flow, q = the velocity pressure, which is the product of one-half the air density by the square of the air speed. Note that reduced pressures are plotted upward, and that the distributions are for the same lift.

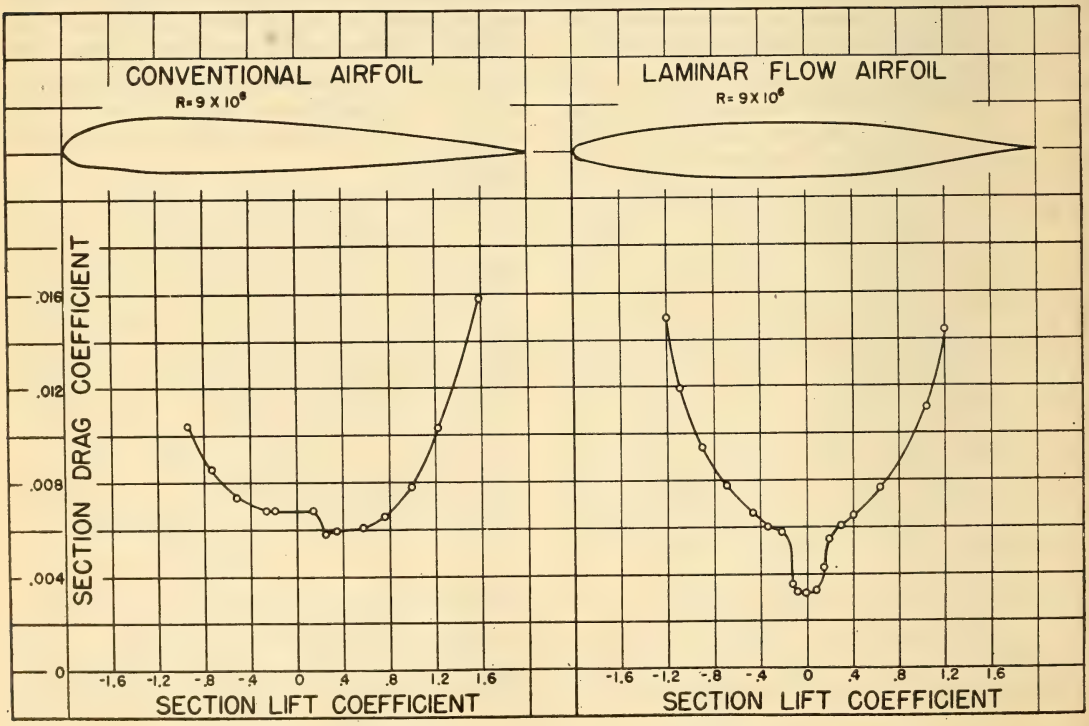


FIG. 3.—Drag coefficients for conventional and laminar flow airfoils.

the "smoothing" of a rough metal surface. To smooth a rough casting one uses a coarse file or rasp which itself has a rough surface. The rasp actually roughens the surface but with a finer scale than the gross irregularities that it "smooths." By repeating with surfaces of ever finer scales of roughness down to a fine emery cloth, a surface of the desired smoothness is obtained. An air stream is smoothed by the use of wire screens, which remove turbulence of large scale and introduce some of smaller scale. Small-scale turbulence decays rapidly, and if the wires of the screen are sufficiently fine they produce no turbulence. Ordinary wind tunnels have speed fluctuations in the range 0.5 to 1.0 per cent of the mean speed; low-turbulence wind tunnels have been built with fluctuations reduced to the order of 0.02 to 0.05 per cent of the mean speed.

In ordinary wind tunnels it has been observed that the boundary layer near the nose of a body is laminar even when turbulent fluctuations are present if the state of flow is judged by the character of the mean speed distribution. A closer examination shows that there are irregular velocity fluctuations present excited by the stream turbulence and of the character of fluctuations in thickness of the boundary layer. The laminar state continues to a distance from the nose, which is controlled by the amount and scale of the turbulence present, higher stream turbulence causing transition to turbulent flow at a point nearer the nose. G. I. Taylor gave a theory of this effect some time ago and it is fairly well understood.

When the turbulence of the air stream is extremely low, a different phenomenon is observed—regular laminar boundary layer oscillations. The development of wind tunnels of low turbulence in fact made possible a complete understanding of the processes leading to the transition of the flow in the boundary layer from the laminar to the turbulent state. The history of this advance illustrates the international character of science. About 15 years ago W. Tollmien, of Göttingen, published a mathematical theory of the stability of the laminar motion in the boundary layer near a thin flat plate in an air stream flowing parallel to the plate. According to this theory small disturbances of wavelength lying in a certain region would be amplified, whereas disturbances of shorter or longer wavelength would be damped. The wavelength range and limits are functions of the Reynolds number, the name given to the ratio of the product of the speed of the air stream by the boundary layer thickness to the kinematic viscosity of the air. The calculations were repeated and extended by H. Schlichting in 1933. In 1935 my colleagues and I at the National Bureau of Standards under the sponsorship of the NACA studied the flow near a flat plate experimentally and failed to find any evidence of the development of the amplified disturbances described by Tollmien and Schlichting. Experiments at the California Institute of Technology, the Massachusetts Institute of Technology, and Cambridge University, England, likewise failed to show the amplified disturbances. All these investigations were made in ordinary wind tunnels.

In 1940 when a wind tunnel of extremely low turbulence was available, my colleagues G. B. Schubauer and H. K. Skramstad repeated the earlier experiment and in August 1940 obtained records of the velocity fluctuations in the boundary layer of a flat plate by means of a hot wire anemometer as shown in Fig. 4. The frequency of these spontaneously occurring almost-sinusoidal oscillations agreed very well with the value predicted by the Tollmien-Schlichting theory. Their amplitude increased downstream until turbulent motion ensued, at first intermittently and then continuously. It was clear that the oscillations were not observed in the earlier experiments because of the controlling effect of wind tunnel turbulence.

Schubauer and Skramstad devised an ingenious method of introducing controlled small disturbances of known frequency as illustrated in Fig. 5. The disturbances were produced by vibrating a very thin (0.002 inch) flat ribbon whose mean position was about 0.006 inch from the plate. A magnetic field was produced in the vicinity of the ribbon by electromagnets on the opposite side of the plate, and an alternating

current of the desired frequency passed through the ribbon. The amplitude of the disturbance could be controlled by varying the current. The ensuing fluctuations of speed in the boundary layer were measured by a hot wire anemometer. Frequency, damping, and wavelength could be independently measured.

After this experimental work had been completed, C. C. Lin, a Chinese student at the California Institute of Technology, undertook a revision of the mathematical theory of the stability of two-dimensional parallel flows and a clarification of some features of the Tollmien-Schlichting theory which had been adversely criticized. Lin made a brief report to the National Academy of Sciences (Proceedings, October 1944) and published a complete account in the Quarterly of Applied Mathematics, vol. 3, pp. 117–142, 218–234, 277–301. Lin's calculation gave slightly different results from those published by Tollmien and Schlichting.

Fig. 6 shows the experimental values of the wavelengths of disturbances which are neither damped nor amplified corresponding to the Reynolds numbers indicated, as compared with the theoretical curves of Lin and Schlichting. Disturbances lying within the open loop are amplified; those outside it are damped. For Reynolds numbers below 420, disturbances of all wavelengths are damped. The agreement between theory and experiment is remarkable and similar agreement is found for the independently determined frequency locus.

In the free atmosphere the initial dis-

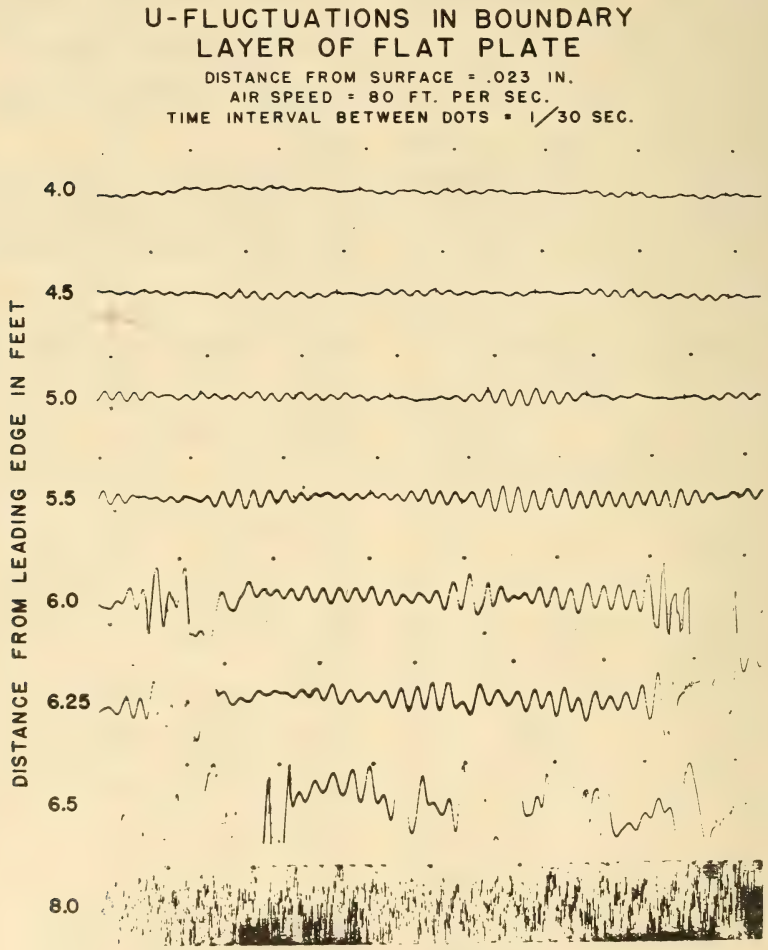


FIG. 4.—Laminar boundary layer oscillations near a flat plate.

turbances may be the sound waves from the engine or propeller. It has been shown by Schubauer and Skramstad that excitation by intense sound waves does in fact produce earlier transition from laminar to turbulent flow, i.e., nearer the leading edge of the plate.

This contribution to aerodynamics is the result of work by German, English, American, and Chinese scientists.

Theoretical computations of the stability of boundary layers subjected to pressure gradients were made by German scientists during the war, and a limited amount of experimental work has been done in this country. As previously mentioned, a falling pressure in the downstream direction greatly increases the stability, the critical Reynolds number being much larger than for the case of uniform pressure. Similarly, a rising pressure makes the laminar flow much more unstable and reduces the critical Reynolds number.

J. Ackeret and his colleagues at the Zurich Aerodynamic Institute have demonstrated that the transition from laminar to turbulent flow in the boundary layer can be prevented by removing a part of the boundary layer by sucking air into the interior of the body through slots or through a porous surface. He was, in fact, able to restore a turbulent boundary layer to the laminar condition. By careful attention to the detailed design of the internal ducting of the suction system he has obtained extremely low drag coefficients. These results are also in conformity with stability calculations made by German investigators.

H. W. Liepmann at the California Institute of Technology studied the effect of the curvature of the surface on the stability of laminar flow. He observed the laminar boundary layer oscillations of the Tollmien-Schlichting type on the convex side of a curved plate, using the oscillating ribbon technique of Schubauer and Skramstad as well as artificial regular roughness of variable wavelength and acoustic excitation. The results agreed closely with those obtained at the National Bureau of Standards, the influence of convex curvature being extremely small. Hence transition on the upper surface of a wing will not be noticeably affected by the curvature of the surface.

For concave surfaces a boundary layer of small thickness (ratio of momentum thickness to radius of curvature less than 0.00005) also exhibits instability of the same type due to Tollmien-Schlichting waves. For boundary layers of large thickness (ratio of momentum thickness to radius of curvature greater than 0.0005) the instability is associated with three-dimensional disturbances of the type predicted and observed by G. I. Taylor for flow between rotating cylinders and studied theoretically by Görtler for boundary layer flow. For intermediate values of the thickness there is a gradual change from one type of instability to the other.

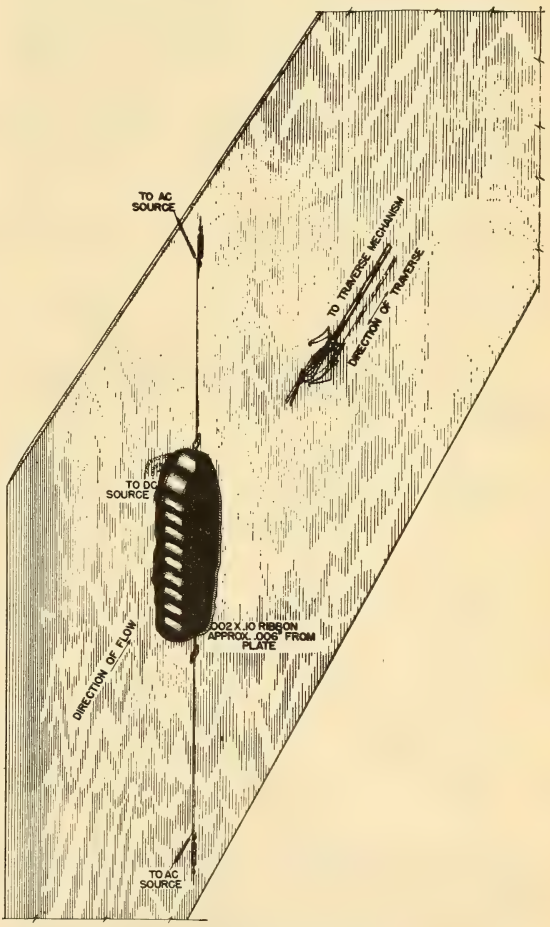


FIG. 5.—Apparatus for producing controlled disturbances in a laminar boundary layer.

The mechamism of the instability of the laminar boundary layer is now quite clear. Small disturbances are always present arising from surface roughness, noise, or stream turbulence, and these will have a certain spectral distribution of energy. The disturbances are selectively amplified by the boundary layer until large sinusoidal oscillations are present. These grow in amplitude, become distorted, and finally produce turbulent motion by a process whose details are not yet fully understood. If initial disturbances are large enough, the required amplification is small and transition is dependent mainly on their magnitude.

Let us now turn our attention to the turbulent boundary layer. Progress in understanding the mechanics of turbulent flow has been slow. Practically all of the methods available for the computation of the flow in turbulent boundary layers are of a type which combine the application of the momentum principle with empirical relations obtained from a few experimental studies. Such developments are of importance to the practical engineer but they do not satisfy one who tries to understand the basic phenomena.

There have been many attempts to form a satisfactory conceptual framework for the construction of a rational theory of turbulent flow. Well over half a century ago Reynolds considered a turbulent flow as consisting of a mean flow on which were superposed fluctuations. He showed that the effect was to introduce six additional stress components in the equations of motion, the components of a turbulent stress tensor. The shear stresses arose from a correlation between the components of the fluctuations. However, no method is known of computing the magnitude of the fluctuations and of the correlations between the several components.

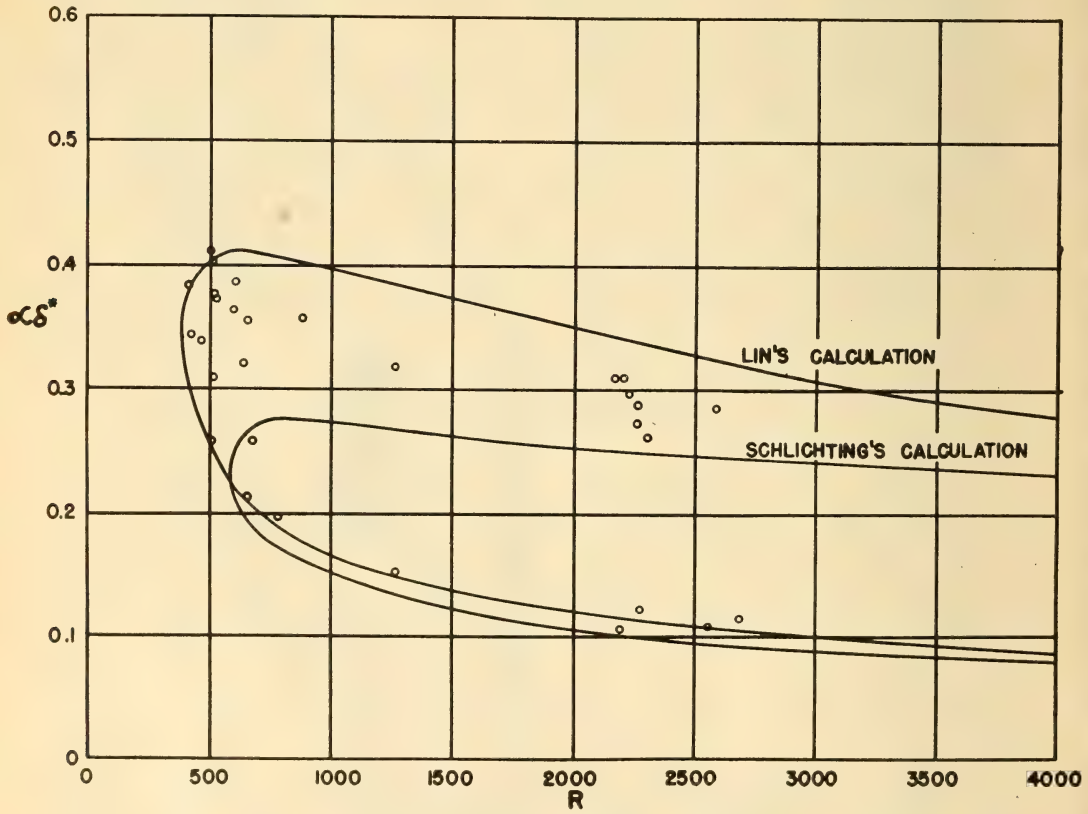


FIG. 6.—Experimental values for wavelengths of neutral oscillations for boundary layer of flat plate as compared with computed values of Lin and Schliciting: δ^* = displacement thickness of boundary layer, $\alpha = 2\pi$ divided by wavelength; R = Reynolds number of boundary layer, equal to ratio of product of speed outside boundary layer times the displacement thickness to the viscosity.

The general analogy between the turbulent fluctuations and the motions of the molecules of the fluid was noticed long ago, and attempts made to consider the effect of turbulent fluctuations as increasing the viscosity, increasing the rate of diffusion, and as transferring momentum or vorticity from one layer to another by processes similar to those considered in the kinetic theory of gases. Prandtl introduced the concept of mixing length as somewhat analogous to the mean free path in kinetic theory. The general theory was developed in terms of the mixing length but some empirical assumption had to be made about the mixing length itself. Prandtl assumed that it was related to geometrical parameters such as distance from the wall and boundary layer thickness. Von Kármán assumed in his similarity theory that the mixing length depended on the velocity gradient and higher space derivatives of the velocity. A characteristic assumption underlying all of these theories is that the velocity fluctuations at a point can be expressed quantitatively in terms of the mean flow in the neighborhood of that point. A disturbing feature is that the mixing length is a considerable fraction (about 0.4) of the thickness of the boundary layer but since an undetermined multiplication factor is always present, misgivings on this point have been ignored.

G. I. Taylor showed how the notion of mixing length could be defined in precise terms for a continuum and developed the foundations of a statistical theory of turbulence.

So long as the experimental material available for comparison with theoretical results was confined to measurements of mean speed distribution, boundary layer thickness, skin friction, and similar quantities, little progress could be made. Widely different mixing length distributions give nearly indistinguishable speed distributions. The hot-wire anemometer has made possible measurements of the fluctuations themselves, of correlations, and of the turbulent stress tensor. Some data have recently become available from experiments by my colleagues Schubauer, Klebanoff, and Squire at the National Bureau of Standards. The results at hand were presented in a paper at the Sixth International Congress for Applied Mechanics in Paris last September, which will soon be published. This is not the occasion to describe the methods or details of the results. I wish, however, to summarize the interpretation placed on the results at the present moment.

Fig. 7 shows the coefficient of shearing stress plotted against the mean velocity gradient for traverses of the boundary layer at three stations. Over extended regions of the boundary layer the velocity gradient changes very little, yet the shearing stress changes by a factor of 4 or 5. These curves do not suggest any very basic relation between the turbulent shearing stress and the mean velocity gradient.

From the measurements of the components of the turbulent stress tensor it is possible to compute the direction of the principal axis of the stress tensor and to compare this direction with the direction of the deformation tensor. The results are shown in Fig. 8. The direction of principal dilata-

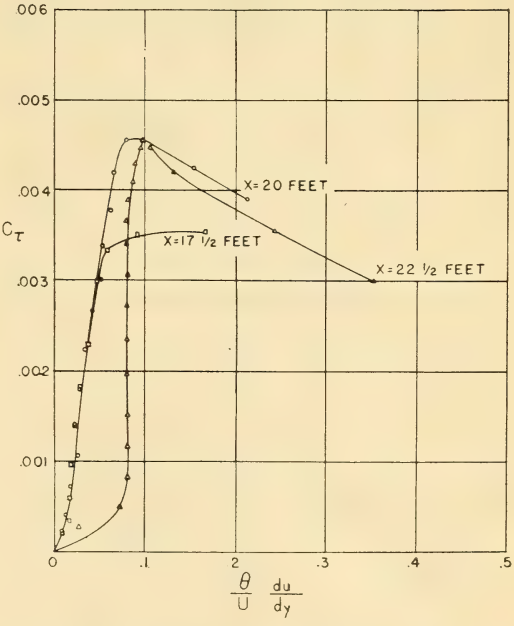


FIG. 7.—Turbulent shear stress coefficient in turbulent boundary layer as function of gradient of mean speed: C_τ = turbulent shear stress divided by velocity pressure; u = local mean speed; y = distance normal to surface; U = mean speed outside boundary layer; θ = momentum thickness of boundary layer.

tion in the approximately parallel shear flow of the boundary layer is at 45° to the flow direction. The direction of the principal axis of the stress tensor is from 10° to 30°. Expressed in more familiar language, there are directions at any point for which there is a shear stress but no rate of shear of the mean flow, and other directions for which there is no shear stress although there is a finite rate of shear of the mean flow. These results can not be explained in terms of a single scalar mixing length and suggest that the turbulent stresses at a point are not simply related to the mean flow in the neighborhood of the point. The stresses probably depend on the diffusion of turbulence from a considerable distance.

Other types of measurements are in progress. For example correlation measurements between fluctuations at points some distance apart in the same cross section of the boundary layer show that the correlation differs from zero over distances comparable with a large fraction of the boundary layer thickness. As further experimental measurements on the fluctuations become available, it is hoped that a more adequate understanding of the phenomena will be obtained.

In terms of the molecular analogy it appears that the "mean free path" or scale of the turbulent processes is large compared with dimensions in which we are interested. We must think in terms of considerable masses of fluid moving more or less coherently. The process can not be smoothed by averaging over a small volume because we can not choose dimensions small compared with those in which we are interested and at the same time large compared to a single fluid element. We are therefore asking ourselves questions of the following types: (1) Shall we regard the flow as a mean flow which merely transports and distorts large eddies superposed on the flow, these eddies being of varying size and intensity? or (2) Shall we regard the flow as a nonstationary flow made up of traveling wave systems, each wave extending across the entire boundary layer and traveling at a speed determined by the geometry of the whole boundary layer, the speed outside the boundary layer, and the physical properties of the fluid? The search is still for that method of approach that will be most useful in understanding the flow.

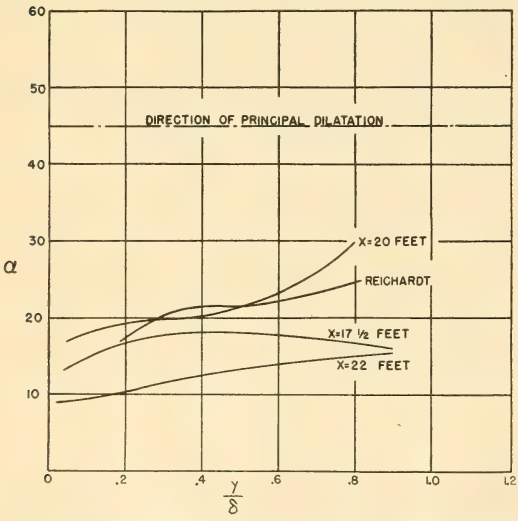


FIG. 8.—Angle between axis of turbulent stress tensor and the direction of mean flow: α = angle in degrees; y = distance normal to the surface; δ = thickness of boundary layer.

Another of the typical situations in complex flow patterns which has received considerable study is that in which the boundary layer separates from the surface, i.e., the direction of flow very near the surface reverses. The separation of a laminar boundary layer is fairly well understood; it arises in the presence of an adverse pressure gradient in the flow outside the boundary layer. After separation the boundary layer persists as a free boundary layer, i.e., region of steep velocity gradient. Transition eventually occurs in the free layer and under suitable conditions the layer may reattach itself to the body as a turbulent boundary layer.

Separation of a turbulent boundary layer also occurs in the presence of an adverse pressure gradient. We are engaged in a study of this phenomenon at the National Bureau of Standards. The results to date show that as separation is approached the turbulent shear stress near the wall falls regularly and smoothly as separation is approached. The falling stress is due to decreased correlation between the components of the velocity fluctuations and not to a decrease in their magnitude.

Perhaps the most obvious development in aerodynamics in recent years is the emergence of widespread interest in high-speed aerodynamics associated with the development of high-speed aircraft, jet propulsion, rockets, and large missiles. High speeds are measured in terms of the Mach number, the name given to the ratio of the speed of the aircraft or missile to the speed of sound. Aircraft are now beginning to operate in the transsonic range, i.e., at Mach numbers between 0.8 and 1.2, in which region the local relative air velocity reaches and exceeds the speed of sound (1127 ft/sec or 767 miles per hour at a temperature of 20°C). Speeds corresponding to Mach numbers greater than 1.2 are termed supersonic speeds.

Supersonic speeds are not new. The 1919 model 16-inch gun fired a projectile weighing 2,340 pounds at an initial speed of 2,700 ft/sec corresponding to a Mach number of 2.4. Until very recently, however, these problems were in the domain of a separate science—ballistics. Now ballistics and aerodynamics are fusing into a single science as aircraft travel faster and missiles sprout wings. In addition to this mating of interests new vitality has been introduced into high-speed aerodynamics by the many physicists and mathematicians who have been brought into contact with its problems during the war. One of the physicists remarked to me that he had been surprised to find that all the problems in fluid mechanics had not been solved in the 1880's as he had supposed; in fact, the subject had proved to be so interesting and the problems so challenging that he had decided to remain in the new field.

The increasing number of mathematicians and physicists working in the field has led to steady progress in developing the fundamental mathematical theory of the transsonic and supersonic flow of a nonviscous compressible fluid, the foundations for which were laid by P. Molenbrock and S. A. Chaplygin nearly 50 years ago. Some of the landmarks in the development before the war were the Prandtl-Glauert linearized equations for subsonic two-dimensional flow, the Kármán-Tsien relation between incompressible and compressible subsonic flows, the Prandtl-Busemann graphical methods for solving problems in supersonic flow, and Ackeret's linearized treatment and Busemann's second order theory of supersonic flows. There were of course many other contributions familiar to workers in the field.

During the war much attention was given to the theory of subsonic and transsonic flow of compressible fluids and somewhat less attention until recently to supersonic flow. In this country the work was sponsored by the National Advisory Committee for Aeronautics; the Bureau of Ordnance, Navy Department; the Ordnance Department of the Army; the Bureau of Aeronautics, Navy Department; the Army Air Forces; and the Office of Scientific Research and Development. Much of the theoretical work is in process of declassification and should soon be generally available.

Here it must suffice to mention only a few items as illustrative of the character of the work, i.e., the development of the theory of supersonic conical flows and their application to a linearized theory of the three dimensional flow about thin airfoils, the application of relaxation methods and the increasing interest in enlisting the aid of the newly developed electronic computing machines in the computation of exact solutions for particular cases.

The theory of transsonic and supersonic flow is complicated by the occurrence of shock waves, representing discontinuities in the flow. The study of this field received tremendous impetus during the war from investigations of flow through tubes and nozzles and blast effect of explosives. The aeronautical group also encountered shock waves as aircraft attained transsonic speeds. A large amount of theoretical and experimental work has been done on the conditions for the appearance of shock waves and the interaction of shock waves with each other and with a solid or free boundary.

Important experimental investigations have been made of the interaction of shock waves and boundary layers on wing sections by J. Ackeret at the Zurich Aeronautical Institute and by H. W. Liepmann at the California Institute of Technology. The shock-wave pattern depends markedly

on whether the flow in the boundary layer is laminar or turbulent and the shock wave does not always cause the flow to separate from the surface, although a characteristic feature of high speed flow as described for example by John Stack of the NACA in the Eighth Wright Brothers Lecture of the Institute of the Aeronautical Sciences is the early separation of the flow from the surface of the airfoil and the accompanying prominent shock wave. The interpretation of these results is that the effects of Reynolds number, i.e., scale, are not independent of the effects of Mach number and vice versa. Knowledge of the state of flow in the boundary layer is essential to the correct interpretation of model experiments at high Mach numbers.

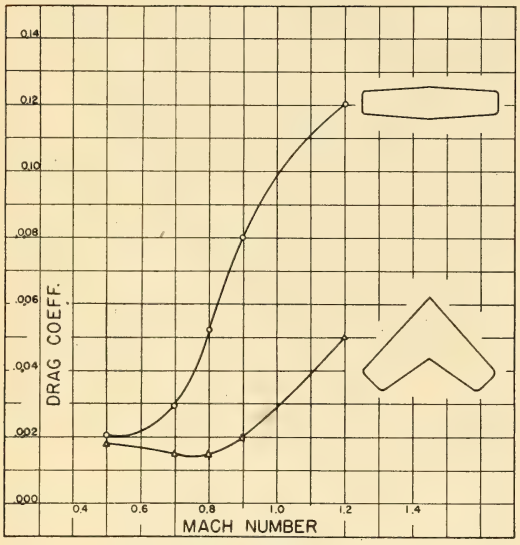


FIG. 9.—Effect of sweep on drag at high speeds: Mach Number = ratio of speed to speed of sound.

The investigators who were sent into Germany at the end of the war to study the accomplishments of German research found many models and a few full-scale aircraft with sharply swept-back wings. The research laboratories had produced many reports on the Pfeilflügel or arrow-wing. This plan form was first suggested for supersonic flight by A. Busemann at a scientific congress in Rome in 1935. At that time, however, no one was seriously interested in achieving supersonic flight, and the idea received little attention. Some time during the war A. Betz, of Göttingen, saw that the use of this plan form would increase the critical Mach number at transsonic speeds, i.e., the Mach number at which the drag increased very rapidly because of compressibility effects. He patented the idea and with other German scientists promoted its application to high speed aircraft. Fig. 9 illustrates the general nature of the benefit to be obtained.

R. T. Jones, of the NACA Langley Laboratory, independently realized the advantages of sweepback, developed a theory, and had made some tests before the German information was available in this country. The theory shows that the flow around a wing of constant section moving through a still fluid is determined solely by the normal component of the velocity of the solid boundaries. Hence if the wing is swept back so that the component of the velocity normal to the span is less than the critical speed for the wing section the flow will have the characteristics of subsonic flow. These advantages of sweepback are offset by some disadvantages which require further study, but this development is considered to constitute an important advance.

Such are some of the recent advances in aerodynamics in its more fundamental and basic phases. Apologies are made to any scientist in the field who may find his accomplishments overlooked in this brief sketch. It is hoped that the declassification of fundamental scientific work and the freer exchange of such information with our fellow workers abroad may permit a more adequate review at some later date.

I have tried to bring to you a little of the fascination of scientific research carried out for the purpose of comprehending physical phenomena and to outline some of the problems in the field of aerodynamics. I think that research carried out in this spirit in all fields of science is essential to progress.

ARCHEOLOGY.—*Note on some potsherds from northeastern Wyoming.*[1] WALDO R. WEDEL, U. S. National Museum.

The handful of pottery fragments on which the following remarks are largely based was collected by George Howes, of Beulah, Wyo., and came to the writer's attention through Dr. F. H. H. Roberts, Jr., of the Bureau of American Ethnology. They are said to have been found by Mr. Howes while he was plowing at his farm on Sundance Creek about 10 miles east of the town of Sundance, in Crook County. The locality is approximately 25 miles east southeast of Devils Tower National Monument and 10 or 12 miles from the South Dakota boundary. Sundance Creek flows northeast across the flank of the Black Hills uplift to drain eventually into the Belle Fourche River just below Belle Fourche, S. Dak.

Twenty-six sherds comprise the sample. In size, none exceeds $1\frac{1}{4}$ inches (32 mm) in greatest dimension, and about half are under 20 mm in diameter. This fact imposes obvious limitations on any inferences that may be drawn, but inasmuch as the type of ware seems not to have been illustrated and described in any detail heretofore it is believed the present series is worthy of record.

When received the sherds were coated with a very tenacious fine red dirt. Their color as revealed after washing was a very dark gray to nearly black, with inner surfaces generally lighter in tone. One bears a thin light reddish exterior layer that resists washing and appears to be a true slip. The others are unslipped, but several have a polished or lustrous outer surface. Tempering consists of small angular bits of sand, used very sparingly. Tiny flecks of mica may be detected in the dark paste. Twenty-four of the sherds are between 3.5 and 5 mm thick, and none exceeds 7 mm.

Included in the series are five rimsherds (Fig. 1, *a–d*, *h*), each of which extends 17 to 28 mm below the lip of the original vessel. The lip in each case bears small diagonal incisions averaging 5 to 7 per inch. Incidental to their application the soft clay was pressed outward so that the lip slightly exceeds in width the thickness of the vessel wall immediately below. Other than this there is no indication of a thickening or reinforcing of the rim which may be regarded as intentional. Paralleling the lip on the exterior surface of three fragments (Fig. 1, *a–c*) are incised lines which may have encircled the vessel. The largest sherd has six of these. There are no lines or other decoration on the two remaining rim pieces other than the ticked lips.

Of the remaining (body) sherds nine bear incising in grouped parallel lines, but owing to the small size of the individual pieces the pattern of which they once formed a part is conjectural. Two of those illustrated (Fig. 1, *f*, *g*) show a series of apparently horizontal lines ending against others running obliquely; the latter may have been either paired diagonals or else the edge of a larger decorative area wherein the hachuring was at an angle to the horizontal. Adhering to the inner surface of the larger is a 1-mm layer of carbonized organic matter. The lines vary from deeply cut narrow incisions to broad round-bottomed grooves. On one small sherd there are shallow indistinct impressions alternating with ridges suggestive of the tooled or paddle-marked surface seen on much of the pottery produced in historic times by the Mandan and Pawnee (Holmes, 1903, pl. 175; Will and Spinden, 1906, pls. 37, 41; Wedel, 1938, pl. 6, *1*). Others have a slightly scratched or brushed appearance, though this may have been unintentionally produced. Six exhibit only plain smoothed exteriors.

Little regarding the associated artifact types and nothing as to the probable form of habitation is known. The ubiquitous "snubnose" or end scraper of the Plains is said to be present as are small projectile points with or without a single pair of lateral notches and leaf-shaped knives or spearheads.

To the best of my knowledge sherds definitely of the type just described have not yet been reported from Nebraska or South Dakota, the States nearest Wyoming

[1] Published by permission of the Secretary of the Smithsonian Institution. Received February 27, 1947.

where archeological fieldwork has to date given true time perspective. However, on leafing through one of my old notebooks containing incidental observations made during a hunting trip in Cherry County, northern Nebraska, I find the following entry under date of November 1, 1931:

"Drove to a very interesting site on the right (south) bank of Snake River, at the bridge leading to the forest reserve, about 2 or 3 miles above the falls. Removal of the sand by wind has exposed a rather firmer black surface, perhaps 3 acres or so in extent. Numerous sherds, all very badly broken up and small, are to be picked up—are characteristically dark gray with a red core, sand or grit tempered, with thin non-collared rims decorated by parallel incised lines which encircled the vessel, and nearly always with tiny diagonal incisions cut into the lip. . . . Arrowpoints are predominantly small and triangular, unnotched, of white or gray chert, etc. Broken animal bones are present, but few if any traces of hearths and none of lodge sites. Is about 50 yards from the Snake River, in a well sheltered location. There are said to be similar sites about 2 miles up Boardmans Creek, which joins the Snake some 2 miles above this site."

The locality referred to is in the central part of the county, approximately 25 miles southwest of Valentine and 8 miles south of Burge Post Office. About one-third of a small full-bodied pot with loop handles, decorated with alternate groups of parallel incised lines and triangular areas filled with minute punctate marks, is said to have been



FIG. 1.—Potsherds from Sundance Creek, northeastern Wyoming.

found on this site. If memory spurred by the above note is to be trusted, the sherds did not vary significantly from those from Sundance Creek.

The Sundance potsherds are reminiscent also of others I have seen from Brown County on the Niobrara, from Antelope and Madison Counties on the middle Elkhorn, and of some described to me but not actually seen from the vicinity of Callaway on the South Loup River. Perhaps the pottery described by Buker (1937, p. 80) from Edgemont, S. Dak., as having "vertical lines interrupted by diagonal sets of parallel lines" is also related. The Elkhorn Valley sherds occurred with small triangular unnotched arrowpoints, grooved mauls, quartzite anvil stones, and, I believe, disk pipe fragments. The decoration on all this pottery somewhat suggests certain protohistoric types in eastern Nebraska, especially Oneota and Lower Loup Focus (Pawnee) wares—or at any rate it approaches these more closely than it does anything yet described for the prehistoric period (Hill and Wedel, 1936, pls. 3–5; Dunlevy, 1936, pls. 4–6; Wedel, 1938, pls. 4, 5; cf. Will and Spinden, 1906, pl. 38). Vessel shapes are unknown, but from the thinness of the sherds generally it is likely the pots were mostly small. Affiliations seem eastern (Missouri Valley) rather than western; the time period indicated is probably late prehistoric or early protohistoric.

Until this particular ware is definitely allocated to a specific archeological complex, its relationships will remain nebulous. Nevertheless, the Pawnee can be safely ruled out as its bearers, since their pottery is on the whole readily distinguishable. It may be significant that the Elkhorn in early historic times was claimed by the Omaha, the Niobrara by the Ponca. Still farther west at various times were the Comanche, Kiowa, and finally the Dakota. Whether one or more of these, or perhaps some entirely different tribe, is to be credited with dispersion of the ware herein described is for the future to disclose.

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GEOLOGY.—*Geology of Hat Island, Great Salt Lake, Utah.*[1] ELIOT BLACKWELDER, Stanford University.

Although the islands in Great Salt Lake, Utah, were visited and surveyed by Captain Stansbury in 1849, little more is known about their geology today than the brief notes in his report.[2] In fact, none of the islands have ever been adequately studied by geologists. One of the most inaccessible of them is a low rocky island known as Hat Island or Bird Island.[3] It is situated in the central part of the lake about 4 miles north of Carrington Island and 12 miles southwest of Promontory Point. In connection with the Salt Lake meeting of the American Association for the Advancement of Science, the writer took advantage of the opportunity afforded by a zoological excursion to visit the island on June 16, 1933.

As seen from the east, the island looks

[1] Received February 10, 1947.

[2] STANSBURY, H. *Exploration and survey of the valley of the Great Salt Lake of Utah, etc.* U. S. 32d Congr. Spec. Sess., Sen. Ex. Doc. 3, 1853.

[3] Although Hat Island is the original name, the locality is more commonly called Bird Island by the people who live in the Salt Lake Basin. The latter name seems undesirable because not distinctive, in view of the fact that sea birds nest in abundance on several other islands in the lake. It is therefore to be hoped that the name given by Stansbury will be preserved.

like a low-crowned black hat resting upon the water. The rocky part is only a few acres in extent and rises about 50 feet above the water level of 1933, which was near zero on the government gauge at Black Point. The island is surrounded by a submerged platform averaging perhaps a thousand feet in breadth. This is thickly encrusted with uneven calcareous tufa, which is apparently being built at the present time. Slimy masses of algae impart to the rounded crusts, or bioherms, a mottled greenish-brown color and are believed to be the causal agents in the formation of the tufa. Spaces between the bioherms are filled with light gray oölitic sand similar in composition to the crusts.[4] At the 1933 stage of the lake the platform was covered with about 3 feet of water, but near the shore of the island was a moatlike depression about 6 feet deep and 100 to 200 feet wide, for which no satisfactory explanation has been suggested. In more normal years the water is 10 to 15 feet deeper. The circumstance reminds one of a coral reef enclosing a lagoon.

Trailing off to the southeast of the island is an embankment of sand and gravel, which was formed as a broad shoal when the lake level stood higher. It consists of wave-worn fragments of hard rock and tufa, mingled with the prevailing oölitic sand.

The rocky part of Hat Island is composed almost wholly of a tilloid conglomerate identical in character with that exposed in Little Mountain, west of Ogden.[5] As in that locality, the rock is typically a massive dark gray argillite, well sprinkled with pebbles and boulders, among which white and gray metaquartzites and pinkish gneiss predominate. The matrix has a rude but evident cleavage, which would warrant calling it a bouldery slate, but the boulders are undeformed. For reasons that have already been sufficiently set forth in the writer's earlier paper, the rock is regarded as probably glacial and is therefore here called *tillite*.

The massive and otherwise structureless tillite is interrupted by two or three beds, or lenses, of stratified graywacke and fine conglomerate 2 to 4 feet thick. These beds were almost certainly comprised of sand and gravel that were sorted and deposited by streams of water, seemingly similar to deposits commonly associated with till in Pleistocene moraines.

On Hat Island neither the bottom nor the top of the tillite is exposed, but the visible thickness is roughly estimated as about 200 feet. The banded or varved slates, which form a significant member of the sequence at the south end of Little Mountain, were not observed on Hat Island.

The beds of graywacke strike N. 20° W. and dip eastward about 30°, whereas in Little Mountain the dip is westward. These relations suggest that the tillite of Hat Island may be the same formation as that in Little Mountain but reappearing on the western side of a broad syncline.

Nothing on Hat Island indicates the age of the tillite, but its similarity to other occurrences in the Salt Lake district suggests that the formation is late pre-Cambrian or possibly Lower Cambrian in age.

[4] Similar deposits and bottom conditions have been well described by A. J. Eardley, as he found them on other parts of the Salt Lake shore. (*Sediments of Great Salt Lake, Utah.* Bull. Amer. Assoc. Petr. Geol. **22**: 1305–1411. 1938.)

[5] Blackwelder, Eliot. *An ancient glacial formation in Utah.* Journ. Geol. **40**: 291. 1932.

ZOOLOGY.—Disoma franciscanum, *a new marine annelid from California.*[1] Olga Hartman, University of Southern California. (Communicated by Waldo L. Schmitt.)

Numerous collections of an unknown member of the Disomidae, dredged by the U. S. Fisheries steamer *Albatross* during 1912 and 1913, form the basis of this report. The family is a small one, known through only scattered references from widely spaced geographic regions. Occurrence of its representatives, even in large collections, is extremely rare. The family is known for only eight (or not over ten) species. The genera, *Disoma* Oersted and *Poecilochaetus* Claparède, are usually the only ones recog-

[1] Received February 18, 1947. The illustrations for this paper were made by Anker Petersen.

nized, but the status of some other names remains enigmatical.

The family name, Disomidae, was erected by Mesnil (1897). It includes Disomididae Chamberlin (1919, p. 370) and Disominae Söderström (1920, p. 271). *Disoma* Oersted (1844) is the oldest genus; it was later named *Trochochaetus* Levinsen (1882) based on a posterior fragment of what later proved to be the genotype of *Disoma.* A later addition, *Nevaya whiteavesi* McIntosh (1911, p. 149) was first placed among the Scalibregmidae, but later shown to be another species of *Disoma* (Fauvel, 1916, p. 3). *Disomides* Chamberlin (1919, p. 370) was proposed to replace *Disoma* Oersted, since the latter was thought to be preoccupied; the family name was thus changed to Disomididae Chamberlin. This change was not required.

Another name, *Thaumastoma* Webster and Benedict (1884), was also referred to *Disoma* by Mesnil (1897, p. 94), but to me this view seems in error. The original and only known description is either incorrect on characters that have major importance or else the individual on which the genus was based departs so widely from all known members of the family that it is hardly inclusive in this group. It was erected for a single species, *T. singulare* Webster and Benedict (1884, pp. 737–739), from Massachusetts. A single injured specimen measured 16 mm long for 22 segments (hence only an anterior fragment). Identity with *Disoma multisetosum* (Oersted) has been suggested (Mesnil, 1897), but this view may have been prompted by the presence of serrated parapodial lobes.

The following characters, based on the description, are at variance with those of *Disoma:* (1) Ventral setae of the first two segments were stated to be in two series, the one capillary, the other stout spines. In species of *Disoma* only the second neuropodium may have spines in addition to setae. (2) The first segment was said to have a median cirrus. (3) The second segment has notopodia provided with a fan of capillary setae, while in front is a thin projecting plate divided into six unequal lobes. When a serrated membrane is present, it is typically postsetal, not presetal, in position. (4) Behind the second segment all setae are capillary; no mention is made of modified acicular spines. (5) In the third segment a digitate plate is said to extend down the side of the body, presetal in position. If the author confused presetal with postsetal positions, in the instances mentioned above, the relations to *Disoma* are clearer, but there are other discrepancies that are not to be explained. Since the only known specimen on which the description was based is not known to exist, it seems advisible to regard *Thaumastoma singulare* as an indeterminable genus and species.

The only other genus of the family, *Poecilochaetus* Claparède (1875) was erected for an aberrant larva for which the sedentary stages were later found. Levinsen (1882, p. 104) recognized the affinities of *Disoma* and *Poecilochaetus,* based on a study of the larval stages of their respective species, but it was not until later that the family Disomidae was recognized and its members separated from those of the family Spionidae (Mesnil, 1897).

The generic name *Poecilochaetus,* like that of *Disoma,* is also obscured by systematic complexities. Much earlier, *Cherusca nitens* Müller (1858, p. 217) from Brazil, was described. Both the genus and species remain enigmatical and unknown except through a brief, original record. However, two characters ally it to *Poecilochaetus;* they are (1) the structure of parapodia, in having foliaceous dorsal and ventral lobes, and (2) the prostomial caruncle which has a branched, median antenna. In other respects the account of *Cherusca* is very sketchy and obscure.

The conclusions regarding the family Disomidae may be summarized as follows: Two genera, *Disoma* and *Poecilochaetus* are recognized. The first includes *Trochochaetus* Levinsen, *Nevaya* McIntosh, and *Disomides* Chamberlin; the second includes questionably *Cherusca* Müller; *Thaumastoma* Webster and Benedict is indeterminable.

Poecilochaetus Claparède is known from the Americas through a single species, *P. johnsoni* Hartman (1939, p. 164) from California. *Disoma* Oersted is known from the Western Hemisphere through two species, both from deep water off eastern Canada:

D. carica Birula, recorded as *Nevaya whiteavesi* McIntosh (see Fauvel, 1932, p. 24), and *D. watsoni* Fauvel (1932, p. 28). A third species, *D. franciscanum*, is described below.

The known species of *Disoma* may be approximately divided into two groups. In one the anterior, postsetal lobes are serrated. To this group belong the genotype, *D. multisetosum* Oersted (1844) known from northwestern Europe, and *D. franciscanum*. In the second group the postsetal lobes are entire. To it belong *D. carica* Birula from northern Europe and eastern Canada, *D. orissae* Fauvel (1932, p. 174) from India, and *D. watsoni* Fauvel (1916, p. 3). The last three named are not clearly distinguishable from one another (Fauvel, 1932, p. 174), since the last two are known through only short, imperfect, anterior fragments.

KEY TO SPECIES OF DISOMA OERSTED

1. Postsetal lobes entire..... .....*carica* Birula, *orissae* Fauvel, and *watsoni* Fauvel
   Postsetal lobes serrated in anterior segments.2
2. Third parapodium with a long cirrus..... .....*multisetosum* Oersted
   Third parapodium without a long cirrus..... .....*franciscanum*, n. sp.

Disoma franciscanum, n. sp.

Figs. 1–3

Collections.—San Francisco Bay, Calif., dredged by the *Albatross* during 1912 and 1913, from the following dredging stations (consult dredging and hydrographic records of the *Albatross*, 1911–1920: Appendix 3 to Rep. U.S. Comm. Fish. for 1920, Bur. Fish. Doc. No. 897, Washington, 1911, for more complete data). D5705 (2) D5706 (2), D5723 (1), D5729 (2), D5744 (1), D5754 (1), D5772 (1), D5828 (1), D5830 (18), D5831 (2), D5838 (many, with tubes). Depths range from 1 to 16 fathoms, bottom of mud and sand to shale.

Description.—Among the numerous individuals listed above, none is complete, but one may estimate the total, probable length from larger fragments. A longer piece, including anterior and median portions measures 60 mm long for 73 segments. Another piece, consisting of only posterior, biramous parapodia measures nearly as long. The total length (preserved) may thus approximate 150 to 200 mm. One of the collections (D5838) contains many tube fragments, some with individuals. Most tubes are flaccid and depressed to cylindrical in cross section; some of the larger ones are about 100 mm long and 6 mm wide. Since the tubes are fragile and easily broken, the total length is probably considerably more than 10 cm.

The body is depressed to cylindrical in cross section. An anterior region of 20 to 25 segments is more or less sharply set off from segments farther back; its rings are both shorter and wider, and its parapodia more fully developed than those farther back. Most individuals have lost the long, paired palpi but some retain longer or shorter portions of these structures, in their normal attachment, at the sides of the prostomial caruncle (Fig. 1, *a*).

The body consists of three regions, (1) an anterior one of about 20 to 25 segments in which parapodia are biramous (except the second segment which is uniramous), (2) a median region of 70 or more segments in which parapodia are uniramous, and (3) a posterior region of 90 or fewer segments in which they are again biramous. The change from anterior to median regions, is transitional in that notopodia come to be gradually smaller and disappear as small papillae. The change from median to posterior regions is also gradual; notopodia again appear gradually, although they never come to be as large. The total number of segments may thus be 150 to 200, consisting of 20 to 25 anterior, 70 or more median, and 90 or fewer posterior, ones. An accurate count is not possible because it is difficult to estimate exact levels where specimens are broken.

The presence of a third body region for species of *Disoma* was first recorded by Levinsen (1882, p. 129), for which he erected *Trochochaeta sarsi;* Michaelsen (1897, p. 41) showed it to be the posterior end of *Disoma multisetosum* Oersted.

The prostomium is an elongate, flat ridge, narrowed and rounded at its anterior margin when the proboscis is retracted, or somewhat weakly trilobed when the proboscis is everted. It widens just in front of the palpal attachentm but narrows again farther back and is continued behind the palpal bases as a narrow caruncle, such as characterizes species of *Poecilochaetus* Claparède. Normally the prostomium is directed downward at its anterior end; thus it is seen with difficulty in dorsal view, and fully

only in frontal view. There are three or four inconspicuous eye spots at the sides of the prostomium, between the palpal bases. They are small in size, more or less deeply embedded and easily overlooked.

The palpi are probably long in life and capable of great extension. Preserved, they are greatly shrunken and fallen from most individuals. As in members of the family Spionidae, they are nearly cylindrical processes and have a deep, longitudinal groove along one side, facing the mouth; they have dark pigment

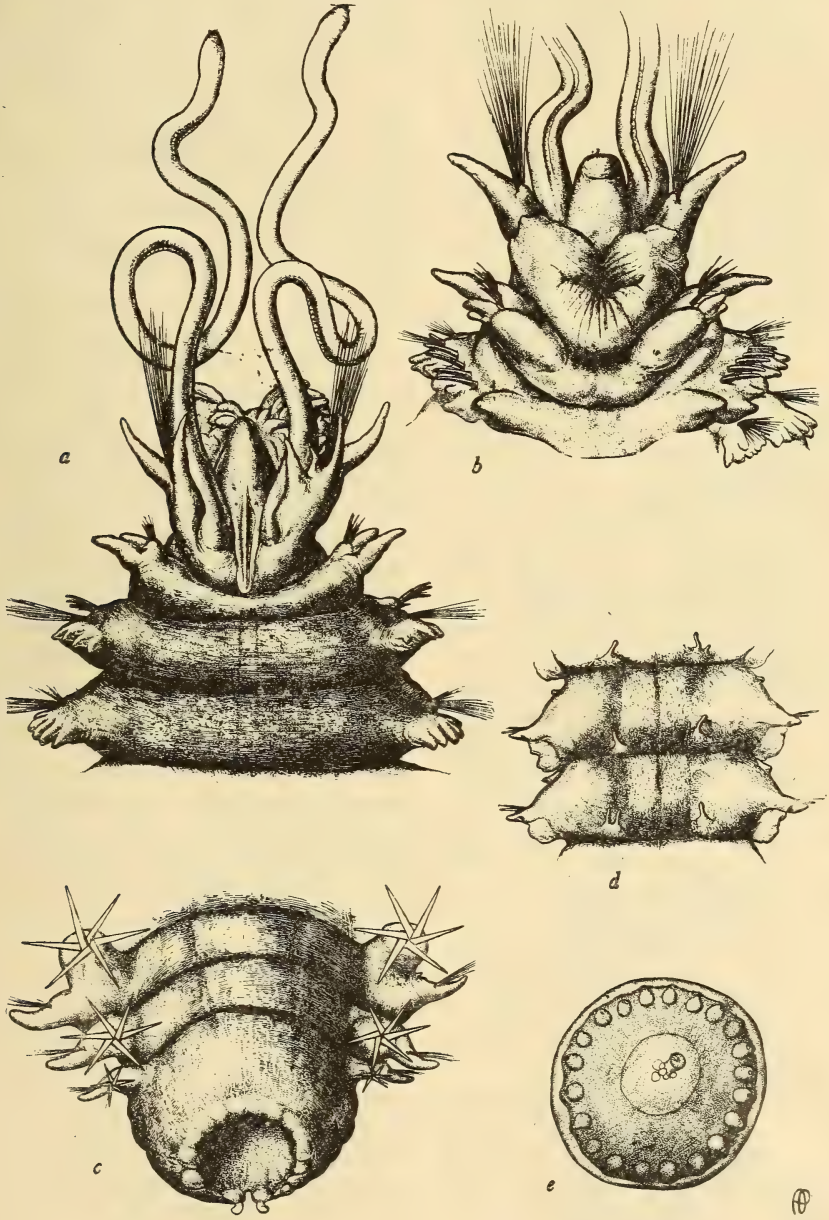


Fig. 1.—*Disoma franciscanum*, n. sp.: *a*, Anterior end including first four segments, with proboscis partly everted, in dorsal view, ×50; *b*, anterior end including first three segments, distal ends of palpi not shown, in ventral view, ×50; *c*, posterior end including pygidium and last three segments, in dorsal view, ×110; *d*, two segments from posterior region of body, in ventral view, ×46; *e*, ovum from body cavity, seen in optical section through the long axis, ×600.

along the sides of the groove. When fallen away, they leave a long, oval scar of attachment at the sides of the prostomial ridge.

The mouth is a large, triangular area on the ventral side of the first segment. When the proboscis is retracted, the anterior and posterior edges of the mouth are strongly ridged (Fig. 1, *b*) and indicate capability of great extension. When the proboscis is extended, the mouth is widely open to permit protrusion of a large proboscis.

The proboscis is a voluminous, thin-walled, much-branched sac, approximately divisible into right and left halves; each half is again divided into short, digitate lobes, the branching largely dichotomous so that each side comes to have 16 to 20 short lobes. When everted, the proboscis covers the lower side of the anterior end of the body. When retracted, it occupies most of the body space in the first four segments. Thereafter, the alimentary tract is slender through 17 segments, except for paired diverticula in each segment; these paired pouches number one set to each segment and are ventrolateral in attachment.

The first segment is biramous and larger in its postsetal lobes than those farther back. It is directed forward so that its setae extend far in front of the prostomium. The notopodial, postsetal portion is a long lobe that is entire, bifid or even trifid at its free end (this character seems to have no significance since those of a single individual frequently differ from each other as shown in Fig. 1, *a*). The neuropodial, postsetal portion is similarly variable or asymmetrical, but usually entire. The setal lobes are short and papillar; they lie immediately in front of the proximal bases of the postsetal lobes. The notosetal fascicle is much smaller than the neurosetal one and its setae shorter and fewer. All setae in the first segment are long, pointed and straight; each fascicle is supported by a single, slender aciculum that is completely embedded.

The second segment (Fig. 2, *b*) is uniramous and its setae are also directed forward but not nearly so far as those of the first one. It is provided with an elongate, triangular, notopodial, postsetal lobe; this may be entire or slightly serrated to form two or three shorter lobes. There is considerable irregularity and asymmetry in this respect, just as for the postsetal lobes of the first segment. There is no notopodial fascicle or papilla (or even notoaciculum). The setigerous lobe is an elongated ridge and provided with four or five projecting, dark-yellow spines (actually the emergent acicula), alternating with, but in front of, five slender, longer, pointed setae. In addition, there are two or three partly developed, dusky embedded acicula at the superior edge of its respective fascicle. This parapodium is somewhat ventral in position as compared with those in front and behind. The heavy spines of this and the next parapodium are probably homologous with the penicillate acicula farther back, and with the single, projecting acicula in parapodia of median and posterior body regions, although they resemble setae in their distal extension. The second and third neuropodia have no other embedded structure.

The third segment (Fig. 2, *c*) is at once distinguishable because of the heavy, dark brown, projecting neuroacicular spines. Parapodia are biramous and project laterally. The notopodium consists of a broad, serrated postsetal lamella in which the upper portion is usually the largest; its setal fascicle consists of 20 to 25 slender, pointed notosetae that resemble those farther back. The neuropodium is much larger and glandular; it has a broad postsetal membrane that is crenulate to serrate at its distal edge. The neurosetal fascicle consists of four or five heavy, dark brown, slightly curved acicula (spines) in a vertical series, anterior to, and alternating with, a similar number of delicate, slender, pointed setae. In addition, there are two dark, partly developed acicula at the superior edge of the series (to be seen only by dissection). The arrangement and general appearance of these bristles is like that for the neuropodium of the second segment, but the acicula are heavier and darker and the setae slenderer and smaller. The inferiormost acicula are anterior to those going progressively upward; the uppermost is therefore posteriormost and the small, embedded, partially developed ones are deeply embedded in the fleshy part of the parapodium. Below the ventral edge of the third parapodium there is a low, thick, glandular pad somewhat resembling a ventral cirrus in its position; it is continued posteriorly on segments 4, 7, 8, and farther back as a diminishing papilla. There is no long cirrus on the third segment, such as is present in *Disoma multisetosum* Oersted.

The fourth segment (Fig. 2, *d*) is characterized for its greatly expanded, serrated, postsetal lobes in both notopodia and neuropodia; they are largest and longest above. The notopodial one has about 13 short distal serrations (or several accessory ones); the neuropodial one has about eight similar, or slightly smaller serrations of which the inferiormost are slightly the larger. The notopodium is armed with 16 to 18 slender, pointed setae supported by a single, slender embedded aciculum. The neuropodium has about 16 similar setae and a single aciculum. The setae resemble those farther back.

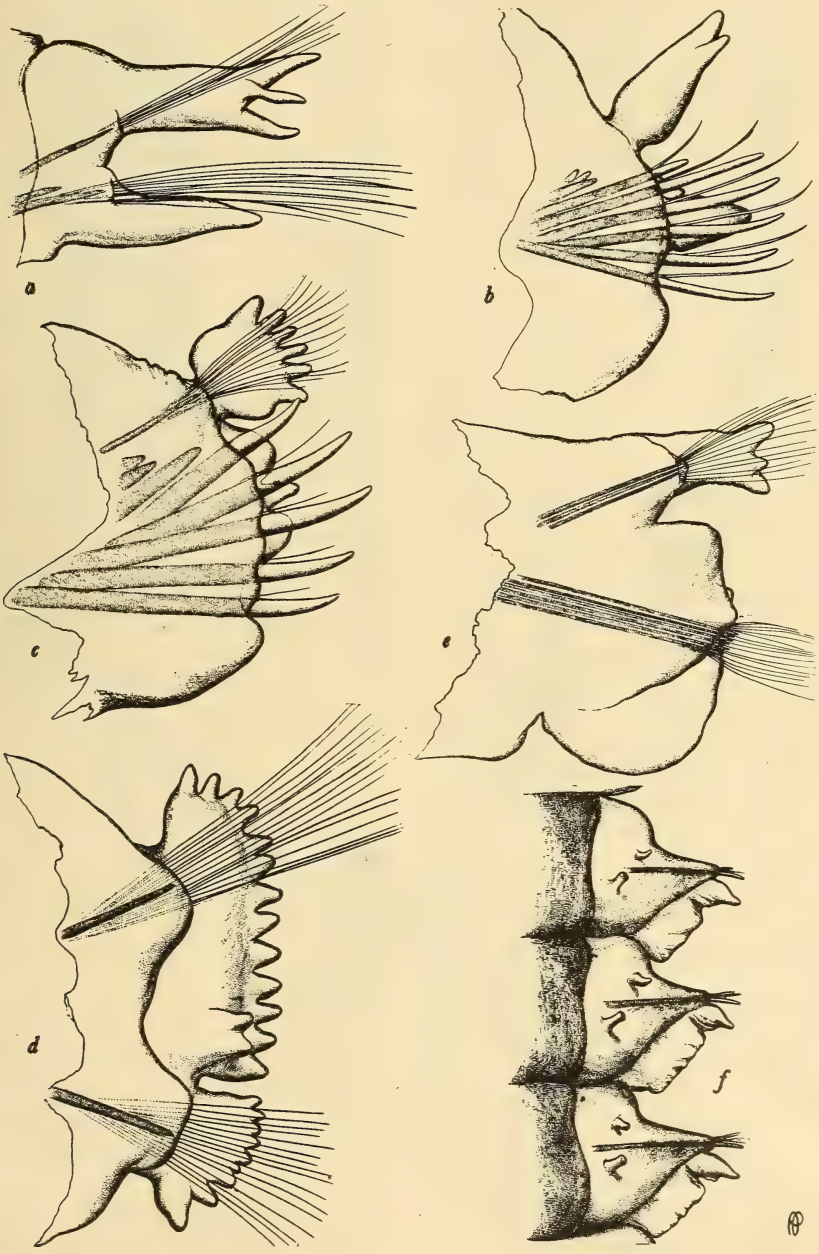


FIG. 2.—*Disoma franciscanum*, n. sp.: *a*, First parapodium in anterior view, ×88; *b*, second parapodium in anterior view, ×112; *c*, third parapodium in anterior view, ×112; *d*, fourth parapodium in anterior view, ×125; *e*, seventeenth parapodium in anterior view, ×112; *f*, right half of three far posterior segments in dorsal view, ×56.

The fifth segment resembles the fourth one but tends to have fewer serrations in its postsetal lobes. There are about nine in the notopodium (or up to six additional, weakly developed ones at the inferior end). Notopodial and neuropodial postsetal lobes are less unequal to each other than those in the fourth segment. The sixth and seventh segments resemble the fifth one but the postsetal lobes have about nine or ten serrations each. By the eighth segment there are only about seven serrations; the ninth and tenth segments have about six serrations in each lobe, the eleventh and twelfth parapodia may have only three or four serrations in each, and between segments 13 to 20 (Fig. 2, *e*) there may be only two to three lobes, or a single one.

Thereafter (i.e., from segment 20 to 25) the notopodium is absent; only neuropodia are developed through a long, median region. Through the anterior region, after the fifth segment, neuropodial postsetal lobes gradually come to exceed the diminishing notopodial, postsetal ones. They come to be deep, fleshy lobes, with both presetal and postsetal ridges well developed, but the latter are the larger and project collar-like behind the setal fascicle. Thus, at a segment near the end of the anterior region, the notopodial postsetal lobe is a narrow, compressed membrane behind the low, papillar, setal fascicle; the neuropodium is a deep, fleshy lobe with an entire, or weakly serrated, postsetal membrane and a short, entire, presetal membrane. Notosetae gradually diminish in size and number to their disappearance. Neurosetae come to form characteristic fascicles; there is a vertical series of preacicular and postacicular pointed setae; these are separated from one another by a similar vertical series of ten to 15 penicillate acicula (Fig. 3, *b*).

Distinct dorsal and ventral cirri are absent. What has been called dorsal cirrus is here interpreted as the postsetal, notopodial lobe, since its position is not dorsal to, but behind, the setal fascicle. The thick pads below the neuropodia in anterior segments are also construed to be glandular rather than ventral cirri. They may participate in secretion of fibers for tube construction, as has been suggested by Thulin (1921, p. 12).

Long, pointed simple setae are present in all notopodia and neuropodia, but those in the second neuropodium are greatly reduced. Acicula are present in all parapodia and some are modified for special uses. Those in the first segment are slender and embedded as are also those in notopodia farther back. Those in the second and third neuropodia are greatly developed and emergent; those in neuropodia of segments farther back come to be penicillate and emergent, functioning probably in tube-construction. The notopodial armature of the posterior region is also acicular, but probably functions for grasping.

The middle region of the body is characterized for lacking notopodia; its segments come to be longer than those in front. The neuropodium consists of a simple, conical papilla; this is armed with a single, heavy, projecting aciculum and a slender tuft of long, pointed setae that resemble those in front. This arrangement is continued through 70 or more segments. A podal membrane is gradually developed; it has its origin immediately behind the neuropodium and extends horizontally back so that it comes to occupy much of the space to the next septum. It comes to be thin and expanded, with frilled margins. These segmental membranes are a conspicuous feature through long median and posterior (Fig. 2, *f*) regions and are continued posteriorly to the end of the body. They recall the parapodial pouches of *Laonice* among the Spionidae, and are similarly found in the region where ova occur.

The transition from middle, uniramous, to posterior, biramous regions of the body is gradual, and marked only by the appearance of small, papillar notopodia, located a short distance above, and within, the neuropodia. Notopodia are low mounds, armed with a close fascicle of four to seven yellow acicula; when retracted they are completely embedded and invisible except for their distal tips. When the notopodium is extended, the acicula are pushed up and out so that they form stellate structures (Fig. 1, *c*); they are not accompanied by setae. These notopodial spines may function for traction. Neuropodia in this region resemble those in the middle region of the body but are successively smaller.

On the ventral side of the body, at about segment 40 to 44, minute, paired ventral papillae make their appearance, immediately within the line forming the proximal portion of the neuropodia. They gradually develop to form

slender, short filaments and come to be most conspicuous in the posterior region (Fig. 1, *d*) where they consist of one to three filaments on a side; they arise from a low mound. These structures were first described by Levinsen (1882) and called branchiae. Michaelsen (1897, p. 41) showed that they are retractile; he recorded their presence for *D. multisetosum* Oersted from about the twentieth segment. Eisig (1914, p. 536) concluded that, morphologically, they are not branchiae since they have their origin away from the notopodium,

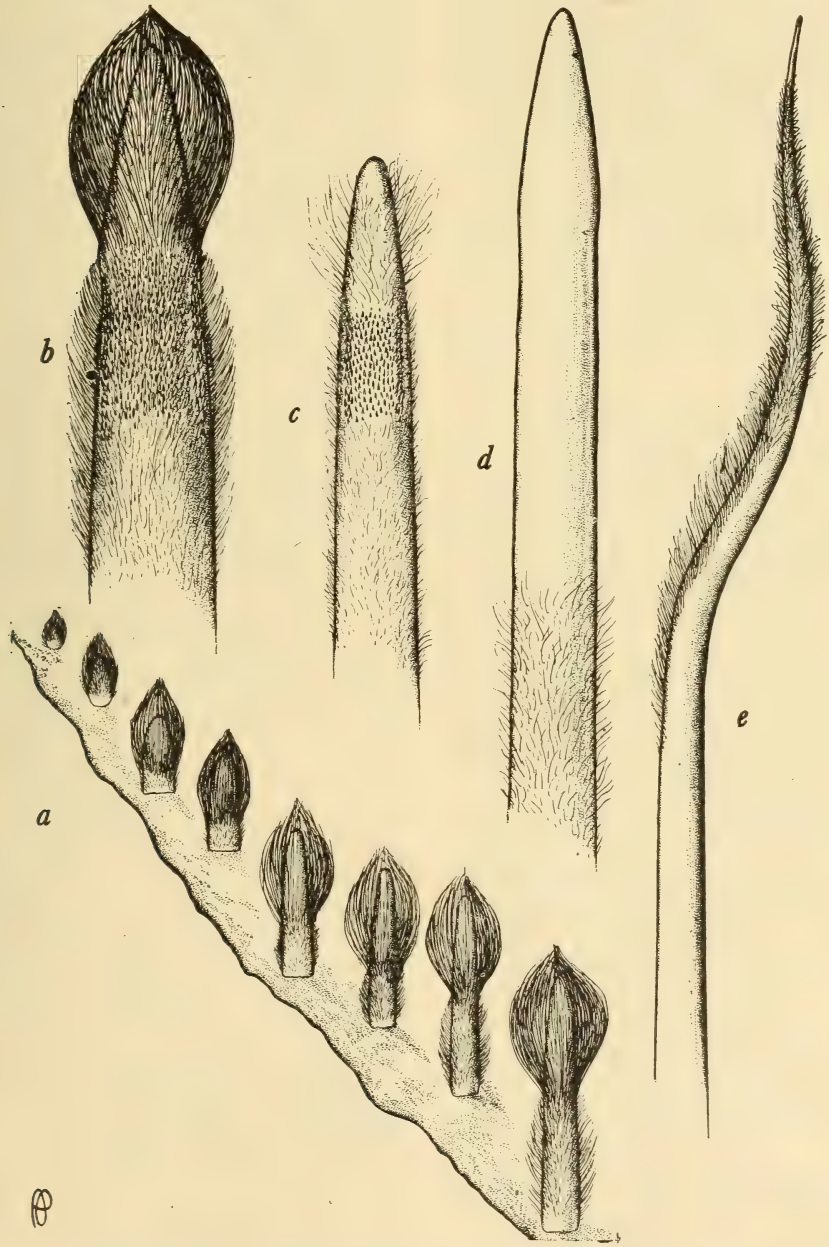


FIG. 3.—*Disoma franciscanum*, n. sp.: *a*, Embedded series of penicillate acicula from seventeenth thoracic neuropodium, showing successive stages in development, ×940; *b*, distal end of developed penicillate aciculum, ×1160; *c*, distal end of emerged penicillate aciculum, with brush partly worn away, ×780; *d*, worn penicillate aciculum from inferior part of fascicle, ×658; *e*, thoracic neuroseta showing fringe at distal end, ×940.

but that they more nearly resemble the lymph branchiae of some capitellids and glycerids. From their position and structure, however, it might be suggested that they function in sensory reception, since parapodia of their respective segments are unusually simple and have few or no lobes for this purpose.

Setae are entirely simple and differ little among themselves except for relative thickness, length and amount of pubescence, if any. Those in the first segment are long, slender, smooth, and nearly straight (Fig. 1, *b*). Farther back they are shorter though still slender and straight. From about the fourth segment they come to be somewhat geniculate and the distal end is covered with a delicate, long pubescence that is irregularly dispersed (Fig. 3, *e*). This hairiness is particularly marked on neurosetae in anterior segments beginning from the fifth one.

Acicula are variously modified. Those of the first segment are slender and embedded. In the second and third neuropodia they are increasingly heavier though still smooth; they are distally somewhat curved and project a considerable distance from the fleshy part of the podium. From the fifth segment the acicula are penicillate (Fig. 3, *a–d*). They are arranged in a vertical series between the setae, with the distal and proximal portions covered with an outer, pubescent sheath. When fully formed, the distal end with its hairs resembles, in shape, the flame of a candle; the subdistal portion of the shaft is slightly rectangular in cross section, with longitudinal rows of spines at the angles, and the proximal portion is covered with pubescence. As the aciculum emerges from the lobe, the distal brush is spread apart, the smooth rod emerges and the pubescence is gradually lost. Various stages (Fig. 3, *a*) of these developing acicula can be found in the superiormost part of the neuropodium, in all segments of the anterior body region, from the fifth one. The embedded fascicle is spiralled and may contain 20 chestnut-colored acicula in various stages of development. Thulin (1921, p. 12) called these acicula "lanzenformige Pinselborsten" and suggested that they function in tube construction.

The body tapers abruptly toward the posterior end and terminates in a thick, collar-like pygidium (Fig. 1, *c*) with a large, circular anal aperture; the ventral edge of the collar is incised and provided with a pair of subspherical, tiny processes which lie proximal to each other, in a transverse direction.

In some individuals ova are present in great number, in the hinder median and posterior segments of the body; in some instances they are believed to be nearly mature. They are flat, lens-shaped, circular or nearly so. The surface is smooth and covered with a thick membrane; beneath the surface there is a circlet of flask-shaped vesicles, numbering 21 to 29 in each ovum; these vesicles are clear and have their narrowed end directed toward the egg membrane (Fig. 1, *e*). Near the center there is a large germinal vesicle or nucleus. The entire structure resembles that of *Poecilochaetus serpens* Allen (1904, pl. 12, fig. 64) and some spionids (Hartman, 1941, pl. 46, fig. 19).

Segmental organs (nephridia) are perhaps present on most segments but they have not been definitely distinguished on anterior segments. They are clearly visible on median and posterior segments as small, paired papillae, each located near the anterodorsal edge of neuropodia (Fig. 2, *f*); they are only slightly visible in ventral view. In the anterior part of the third body region, they resemble the gradually developing notopodia, but their position is in front of, not above, the neuropodium.

The alimentary tract is a straight tube and has few modifications. The mouth leads into the large, voluminous proboscis; this occupies most of the space in the first four segments (when retracted). This is followed by a long, slender, cylindrical esophagus that extends distally through the next eleven segments; it has paired, thin walled, ventrolateral pouches, one pair to each segment. The esophagus gives rise to the gradually widening thin walled intestine farther back. The intestine is usually filled with fine, granular materials, perhaps sand, shell and other inert materials, from which the organic foods may be sifted.

The tube of *Disoma franciscanum* is long and cylindrical to somewhat flattened. It tapers slightly to a constricted aperture at the forward end. Its walls consist of finely compacted, rust-colored mud; its inner walls are smooth but there is no membranous lining. The tubes are easily broken lengthwise or crosswise. There is no indication of anastomosing which Thulin (1921, p. 11) described for *D. multisetosum* Oersted.

According to Thulin (loc. cit.) the tube materials are held together by longitudinally arranged fibrils that are secreted from spinning glands, probably located in an anterior portion of the body. This author suggests that the process may be likened to that in some species of *Panthalis* (family Polyodontidae) described by Watson, where the fibrils are formed by certain spinning glands and spread out with the aid of penicillate bristles which carry the fibrils out to the walls of the tube, aided by the movement of other setae.

D. franciscanum resembles *D. multisetosum* Oersted in some respects, especially in having serrated postsetal lobes in anterior parapodia. It differs sharply, however, in that there is no long cirrus on the third parapodium. The former is provided with heavy projecting acicula in both the second and third parapodia but those of the third are by far the heavier. Segments of the middle body region are uniramous. Neuropodia of middle and posterior body regions are provided with a horizontal, lamellar membrane that comes to be pouchlike. Ventral papillae are present from about the fortieth segment and continued posteriorly to the end; they number usually one or two filaments to a segment, on each side.

Holotype.—U.S.N.M. no. 20912.

Type locality.—San Francisco Bay, Calif.

Distribution.—San Francisco Bay, Calif., in 1 to 16 fathoms, associated with sand, mud, and shale.

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ZOOLOGY.—*A new harpacticoid copepod from Bornean crabs.*[1] ARTHUR G. HUMES, University of Connecticut. (Communicated by WALDO L. SCHMITT.)

A new copepod species from the gill chambers of various marsh crabs was collected at Tarakan, Borneo. The copepods were stained lightly with acid fuchsin, cleared in cedarwood oil, and mounted in clarite, either whole or in segmental dissections to show the appendages. The mouth parts and body segments with their appendages were separated using sharply pointed minuten nadeln.

Identifications of the Bornean crabs were made by Dr. Fenner A. Chace, Jr., of the U. S. National Museum. Paratypes and other specimens of the Japanese species were lent for study by the same museum. Service with the U. S. Navy in Borneo afforded opportunity for the collection of the new material.

Family CANTHOCAMPTIDAE

Pholetiscus, n. gen.

Generic characters.—General body shape resembling that of *Cancrincola* Wilson. Female abdomen 3-segmented; male abdomen 4-segmented. Caudal rami moderately short, both bearing terminally a seta two-thirds as long as the body and a shorter seta about one-fourth the length of the other. No anal operculum. Anterior antennae of female with six or eight podomeres; those of the male highly modified for clasping with three to eight podomeres difficult to distinguish. Posterior antennae short, with two or three podomeres, the exopodite minute or apparently absent. Mouth parts in general plan similar to those of *Cancrincola*, but differing in details. Swimming legs all biramous, first pair modified for clasping; in female exopodites 1–4 with three podomeres, endopodites 1–4 with two podomeres; in male rami are similar except for the third endopodite which has three podomeres. Fifth legs in female lamellar, with two podomeres, the basal one indistinctly separated from the body segment and expanded on the inner side; the distal podomere bearing two setae. Fifth leg in male reduced to a low ridge bearing three or four setae. A single ovisac.

Genotype.—*Pholetiscus wilsoni* (Pearse) = *Cancrincola wilsoni* Pearse, 1930.

[1] Received February 3, 1947.

Remarks.—This new genus may be easily separated from the genus *Cancrincola* on the basis of the several distinctions mentioned below. It includes the new species, *Pholetiscus orientalis,* herein described, and the species originally described by Pearse (1930) as *Cancrincola wilsoni.*

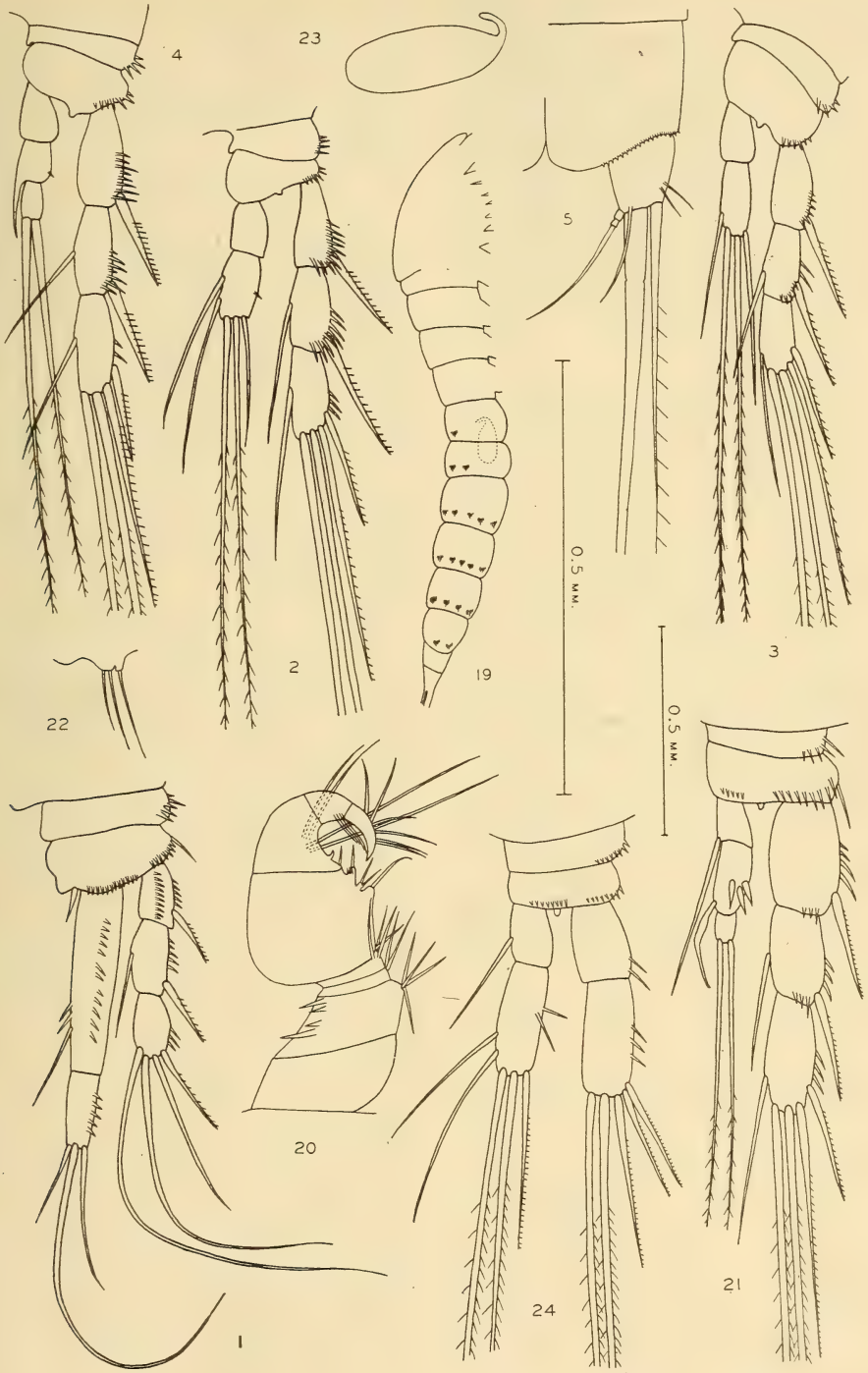
Pholetiscus wilsoni (Pearse, 1930)

This species was first described from the gill chambers of two marsh crabs, *Sesarma haematocheir* (de Haan) and *Sesarma pictum* (de Haan), at Aburatsubo, Japan. An examination of Pearse's specimens, U.S.N.M. no. 62836, from *S. pictum,* apparently paratypic though not so labeled, shows several features not mentioned in the original description. The sixth thoracic segment (genital) has a weak transverse division dorsally, not seen on the ventral side. The female abdomen is 3-segmented, while that of the male is 4-segmented.

The anterior antennae of the male have more than three podomeres. The joints are difficult to interpret but the podomeres are similar to those of *P. orientalis* to be described below. Podomeres 3 and 4 are very poorly delimited, and are indicated only by slight differences in the thickness of the chitin to be seen in optical section. Podomere 5 is swollen at the outer proximal angle. Fifth and sixth podomeres bear rough protuberances on their inner margins. Seventh and eighth podomeres are indistinctly separated and curved back toward the fifth to form a prehensile organ. The anterior antennae of the female have six podomeres, the sixth perhaps representing the fusion of two or more podomeres. The relative lengths of the podomeres beginning basally are 9:8:5:5:3:7.

Whether the low protuberance at the base of each posterior antenna should be regarded as a distinct podomere is a matter for interpretation. Including this protuberance, the posterior antennae apparently have three podomeres.

The first four pairs of legs resemble in general those of *P. orientalis* described below. Since various setae were omitted in the original description, certain legs will be redescribed here. In the first leg of the female (Fig. 1) the proximal podomere of the endopodite bears a long, slender seta and two minute ones on the distal



FIGS. 1–5.—*Pholetiscus wilsoni* (Pearse): 1, First leg (female); 2, third leg (female); 3, fourth leg (female); 4, third leg (male); 5, caudal ramus (male).

FIGS. 19–24.—*Pholetiscus orientalis*, n. sp.: 19, Body segments (male); 20, anterior antenna (male); 21, third leg (male); 22, fifth leg (male); 23, spermatophore; 24, asymmetrical third leg (female).

All figures drawn with the aid of a camera lucida. The shorter of the two scales applies to Figs. 1–5; the longer only to Figs. 6 and 19.

third of the inner margin. The second podomere of the exopodite bears a seta on the inner side. The second pair of legs was completely figured in the original description. The third pair of legs (Fig. 2) resembles that of *P. orientalis* below except for the absence of a seta on the inner distal angle of the proximal podomere of the endopodite. The fourth pair of legs (Fig. 3) differs from *P. orientalis* below in the absence of setae on the proximal podomere of the endopodite and presence of a long seta on the inner distal region of the second podomere of the exopodite.

In the male the first and second legs are like those of the female. The third pair of legs (Fig. 4) has an endopodite of three podomeres instead of two as given in the original description. The first endopodite podomere is without setae; the second bears a prominent, deeply staining, falciform projection at the inner distal angle and a single small seta on the outer margin; the third is slightly smaller than the preceding two and bears terminally two sparsely plumose setae about 3 times as long as the endopodite itself. The exopodite resembles that of *P. orientalis* to be described. The fourth pair of legs is like that of the female.

In both sexes between the bases of the two rami on the second, third, and fourth legs there is a small projection which stains brilliantly with acid fuchsin.

The arrangement of setae and spines (excluding the groups of variable small setae) on the first four pairs of legs is expressed numerically in Table 1.

The caudal rami (Fig. 5), alike in both sexes,

TABLE 1.—ARRANGEMENT OF SPINES AND SETAE ON SWIMMING LEGS 1–4 OF PHOLETISCUS WILSONI (PEARSE)

Swimming leg		Female			Male		
First pair	exopodite	1,0	1,1	4	1,0	1,1	4
	endopodite	0,1	3		0,1	3	
Second pair	exopodite	1,0	1,1	5	1,0	1,1	5
	endopodite	0,0	3		0,0	3	
Third pair	exopodite	1,0	1,1	5	1,0	1,1	5
	endopodite	0,0	5		0,0	0,1	2
Fourth pair	exopodite	1,0	1,1	5	1,0	1,1	5
	endopodite	0,0	4		0,0	4	

Numbers to the left of the comma refer to the number of large spines or setae on the outer edge, those to the right to the number on the inner edge. Single numbers refer to terminal armature. Minute spines or setae are not considered because of their relatively wide variation in number. Scheme adapted from that of Kiefer (1928).

resemble those of the Bornean species to be described, but differ in the two long terminal setae having separate bases. The shorter of the two terminal setae is about one-fourth the length of the longer (which in one female measured 350μ).

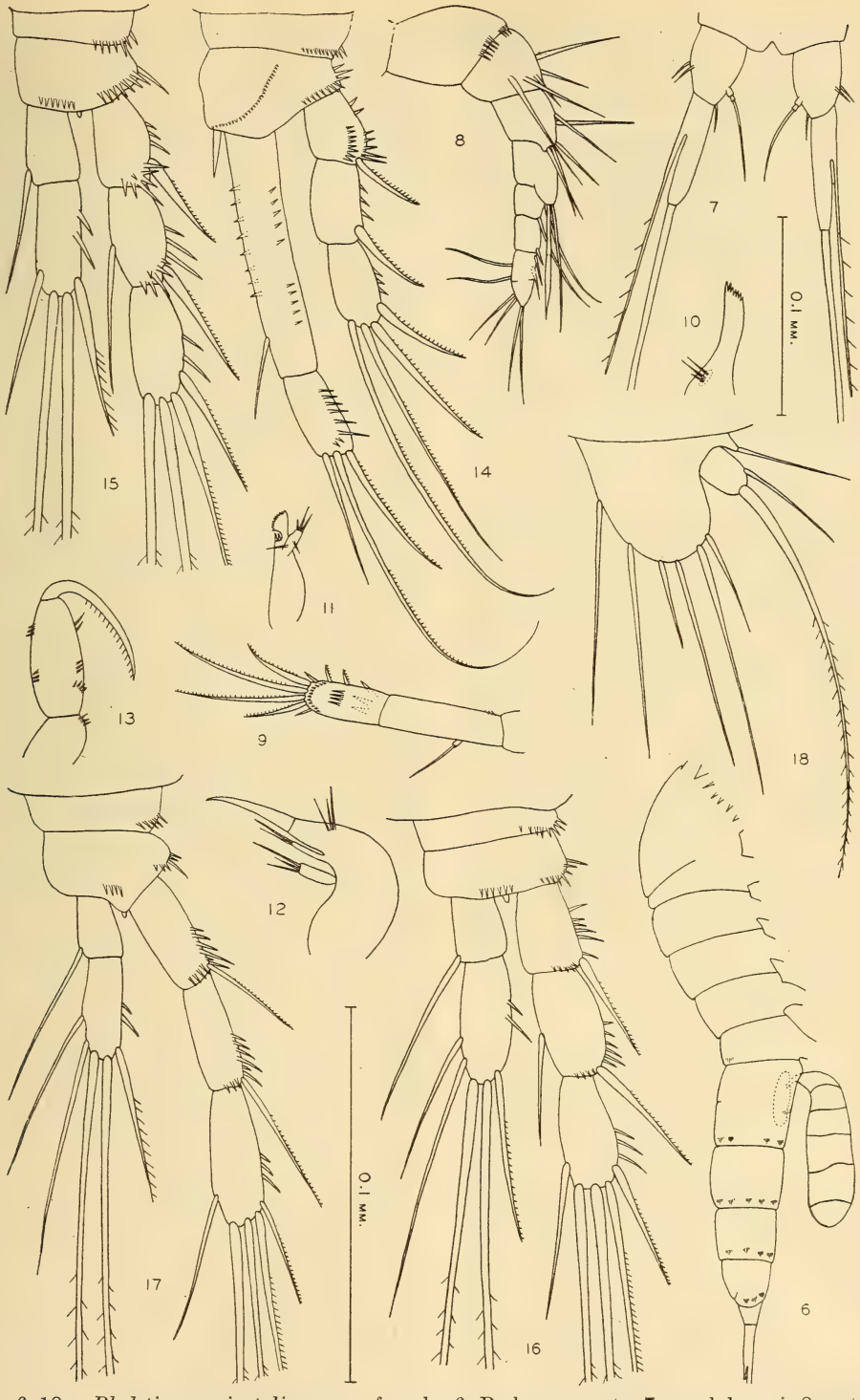
Pholetiscus orientalis, n. sp.

Type material, consisting of more than 70 individuals representing both sexes, from the gill chambers of three species of brachyurans, *Sesarma eumolpe* de Man, *Sesarma taeniolatum* White, and *Sesarma palawanense* Rathbun (the specific determination of the last-named being somewhat uncertain), collected on August 6, 1945, at Tarakan, Dutch Borneo. Holotype, female, U.S.N.M. no. 82266; allotype, U.S.N.M. no. 82268; 30 paratypes including both sexes, U.S.N.M. nos. 82267 and 82269–82293; the remaining paratypes in the author's collection.

Female.—Body moderately slender. Length about seven times the greatest width. Metasome slightly shorter than urosome, both somewhat cylindrical but tapering posteriorly. Cephalic and first thoracic segments approximately equal to the length of the second, third, and fourth thoracic segments combined, well developed laterally, without setae. Rostrum minute, rounded anteriorly and unarmed.

First segment of the 6-segmented thorax usually only indistinctly separated from the head, the dorsum being shorter than that of any of the succeeding thoracic segments. Second, third, and fourth thoracic segments similar to each other in size and shape. Fifth segment with dorsum somewhat shorter than that of the fourth, not telescoped with adjacent dorsa (Fig. 6). Sixth segment of the thorax (genital), bearing a single ovisac at the midventral anterior margin, longer than any of the first five segments and having dorsally a weak transverse division. First four thoracic segments without setae; segment 5 with a vertical row of 6 minute setae (forming a ctenidium) near the posterior lateral margin; segment 6 with a vertical row of four ctenidia each composed of five or six setae on both sides.

Abdomen 3-segmented, third segment slightly shorter than the second and first but all shorter than the sixth thoracic. First abdominal segment with five ctenidia on both sides; second segment with four ctenidia, lack-



FIGS. 6–18.—*Pholetiscus orientalis*, n. sp., female: 6, Body segments; 7, caudal rami; 8, anterior antenna; 9, posterior antenna; 10, mandible; 11, first maxilla; 12, second maxilla; 13, maxilliped; 14, first leg; 15, second leg; 16, third leg; 17, fourth leg; 18, fifth leg.

All figures drawn with the aid of a camera lucida. The shorter of the two scales applies only to Fig. 7; the longer to Figs. 8–18 and 20–24.

ing the dorsal one; third segment with three ctenidia, lacking both dorsal and dorsolateral groups, and deeply incised in the anal region.

Caudal rami (Fig. 7) shorter than the anal segment, armed on the outer side with two small equal setae and on the inner distal region with two setae, the proximal one of which being four times the length of the distal one and set upon a 2-jointed pedicel. On the posterior end of both caudal rami an elongated portion nearly twice the length of the caudal ramus; bearing at a point slightly less than halfway to the distal end on the outer margin a long seta, four times the length of the caudal ramus and having seven equidistant hairlike projections along its outer edge beginning at a point nearly one-half the distance from its base; bearing terminally a much longer, slightly curved seta about two-thirds of the body length and finely plumose along the distal two-thirds.

Anterior antennae (Fig. 8) with eight podomeres, the joint between 7 and 8 weakly chitinized or indicated only by a thin area in the chitin. With numerous setae ventrally on podomeres 2–8. On the first podomere a distal, ventrolateral row of about eight setae; distal ventral area of podomere 3 slightly projected and bearing three setae; the same area of podomere 4 strongly projected, bearing two unequal setae, the ventral one long and slender, the dorsal one of nearly equal length but swollen along the distal third and in stained specimens showing a lightly chitinized ring at its midregion; seventh podomere with two dorsal setae; eighth indistinctly separated from the seventh and bearing two setae dorsally and two longer ones terminally.

Posterior antennae (Fig. 9) shorter than the anterior pair, with apparently three podomeres and a monomerous exopodite. Basal podomere very short and wide, consisting of a low protuberance upon which the antenna is set. Second podomere cylindrical, bearing near the center of the outer margin an exopodite consisting of a minute cylindrical piece with a single terminal seta, and having basally on the inner margin three minute setae. Distal podomere with a row of three strong setae near the base, a row of four weaker setae on the surface of the distal half, and an arched row of 12 smaller setae along the distal margin; terminally a row of four strongly developed, pectinate setae and laterally at both ends of the row a short seta; on the inner side of the distal podomere two short, stout, pectinate setae.

Mandibles (Fig. 10) minute, slender, about 30μ in length, with a group of seven teeth distally and on the outer side near the base three setae arising from an indistinct oval area, perhaps representing an exopodite.

First maxillae (Fig. 11) approximately the same size as the mandibles, consisting of an elongated basal portion having a terminal, flabelliform projection finely dentate distally and two small adjacent setae, and bearing laterally an outer cylindrical piece with three terminal and two lateral setae.

Second maxillae (Fig. 12) slightly larger than the preceding pair, consisting of an elongated recurved basal part provided terminally with a long, slightly curved claw and on the inner side two cylindrical projections bearing two and three setae, respectively, and having a group of three small setae on the outer side near the base of the claw.

Maxillipeds (Fig. 13) with two podomeres and a terminal claw, prehensile (with three podomeres if the claw is regarded as a true podomere); proximal podomere short with three minute setae at the inner distal angle; distal podomere elongated with three groups of setae on the inner edge and two groups on the outer margin, bearing terminally a slender, curved claw nearly as long as the podomere itself and pectinate along its concave distal two-thirds.

First four pairs of swimming legs biramous, the first pair adapted for clasping, the following three for swimming; endopodites with two podomeres, exopodites with three. The fifth pair of legs highly modified. First pair of legs (Fig. 14) with a dimerous basipodite, its anterior surface bearing short spines in rows; the proximal part armed with a transverse row of 10 spines along its outer angle; the distal part with a similarly placed row of 13 spines, an oblique row of about 30 minute spines extending from the midbasal region to the inner angle, and a large stout seta at the inner distal angle. Exopodite of three similar podomeres, unarmed medially, each armed with a stout pectinate seta at the outer distal angle; the first podomere with two rows of five and eight setae respectively distally and two isolated setae proximally along its outer margin; the second and third podomeres with three setae along

the outer margin; terminally on the third podomere a row of three prominent setae, the inner two longer than the exopodite itself and pectinate medially, the outer one half as long, stouter, and pectinate. Endopodite nearly one and one-half times the length of the exopodite, with two podomeres; the proximal podomere three times the length of the distal one, armed on the outer side with two longitudinal rows of five setae and on the inner margin with a central row of eight setae and a single larger seta near the inner distal angle; the distal podomere with a row of six spiniform setae on the outer margin, two smaller setae at the distal end of the row, and terminally three setae, the outer one stout and pectinate, the middle one as long as the endopodite itself, slender and pectinate along its midlength, the inner one slender and much shorter.

Second pair of legs (Fig. 15) with a dimerous basipodite having a row of spines at the outer distal angles of the two parts and a third row near the base of the endopodite; between the bases of the rami a small projection which stains brilliantly with acid fuchsin. Exopodite with three similar podomeres, each armed with a stout pectinate seta on the outer distal angle; the first podomere with a row of three setae on the outer margin and a group of seven spiniform setae on the outer distal angle; the second with similar setae, and in addition a long, slender seta arising from the center of the inner margin; the third with two setae on the outer margin and three long terminal setae, the outer one pectinate, the other two slender, longer than the exopodite itself and feathered, the inner of the two more sparsely so. Endopodite with two similar podomeres, the proximal one slightly shorter; both bearing a long seta at the inner distal angle; the distal podomere with two small setae on the outer margin, a pectinate seta at the distal outer angle, and terminally two long setae which are plumose in the distal half.

Third pair of legs (Fig. 16) similar in most respects to the second. Exopodite with three similar podomeres, the setal arrangement like that of the second exopodite, but with variations in the number of small setae and with the addition of a seta at the inner distal angle of the third podomere. Endopodite with two podomeres, similar to those of the second endopodite but with the addition of a long seta between the inner terminal seta and the seta at the inner distal angle.

Fourth pair of legs (Fig. 17) resembling the second. Exopodite with three equal podomeres, the setal arrangement similar to that of the third exopodite, but with variations in the number and with the deletion of the inner seta on the second podomere. Endopodite with two podomeres, similar to those of the third endopodite.

The setal arrangement of swimming legs 1–4 is expressed numerically in Table 2.

Fifth legs (Fig. 18) uniramous, lamellar, with two podomeres, the basal one with a single seta on the outer corner and expanded on the inner side into a broad lamina bearing terminally a row of six setae, the outermost and the third from the midline being distinctly shorter than the others which are nearly twice as long as the lamina; distal podomere oval with two unequal setae terminally, the inner one more than three times the length of the lamina and plumose on its distal half.

A single ovisac containing 7–11 eggs, each approximately 50μ in diameter, in a single layer.

Measurements based upon 10 females are as follows: Total length exclusive of setae, 0.637 mm (0.588–0.705 mm); greatest width (at first thoracic segment), 0.094 mm (0.080–0.110 mm); length of caudal setae, 0.431 mm (0.426–0.514 mm).

Color in living specimens transparent to opaque white.

Male.—General body form similar to that of the female, but slightly smaller in size (Fig. 19). Sixth thoracic segment not distinctly longer than adjacent segments. Fifth thoracic segment with a posterior dorsolateral group of minute setae on both sides. Sixth thoracic segment with two linear groups of such setae. Abdomen 4-segmented, the sides of the first and second segments with five linear groups of minute setae, the third with four and the fourth with two such groups. Caudal rami as in the female.

Anterior antenna (Fig. 20) highly modified for clasping, with eight podomeres (the number being difficult to distinguish) with their joints strongly chitinized; first podomere without setae; second with four spiniform setae arising from the outer side, and four slender setae situated on a slight projection on the

inner side; third and fourth podomeres very short with several setae on the inner margins; fifth very large and swollen along the outer proximal angle with several setae on the inner margin, some on conical projections; sixth concave on inner margin from which arise two pairs of long setae and one or more stout knoblike ridges; seventh with inner surface half the length of the outer edge and bearing at the distal angle a group of filamentous setae; eighth podomere terminally pointed and clawlike, with six setae arising from its convex outer edge; the whole arranged so that the tip of the eighth podomere may be brought in contact with the inner distal angle of the fifth.

Second antennae, mouth parts, and first and second legs similar to those of the female. Third pair of legs (Fig. 21) with basipodite and exopodite like those in the female, but endopodite with three podomeres instead of two; the first armed with a long seta at the inner distal angle; the second slightly longer, bearing three short, stout setae near the middle of its outer margin and a falciform projection (its articulation difficult to distinguish) at the inner distal angle; the third podomere distinctly smaller, about half the length of the first, the joint separating it from the second often not strongly chitinized, and bearing terminally two long setae which are sparsely plumose distally.

Fourth pair of legs like that of the female but usually lacking the two inner distal setae, rarely only one, on the second podomere of the endopodite.

The setal arrangement of swimming legs 1–4 is shown in Table 2.

TABLE 2.—ARRANGEMENT OF SPINES AND SETAE ON SWIMMING LEGS 1–4 OF PHOLETISCUS ORIENTALIS, N. SP.

Swimming leg		Female			Male		
First pair	exopodite	1,0	1,0	4	1,0	1,0	4
	endopodite	0,1	3		0,1	3	
Second pair	exopodite	1,0	1,1	4	1,0	1,1	4
	endopodite	0,1	4		0,1	4	
Third pair	exopodite	1,0	1,1	5	1,0	1,1	5
	endopodite	0,1	5		0,1	3,1	2
Fourth pair	exopodite	1,0	1,0	5	1,0	1,0	5
	endopodite	0,1	5		0,1	3	

See Table 1 for explanation of numbers.

Fifth legs of the male (Fig. 22) very much smaller than in the female, reduced to a low lamellar ridge with three setae, the outermost the longest and set upon a cylindrical base, the innermost the shortest. The two internal setae are borne upon a low projection separated by a groove from the base of the external seta. Medially to the three setae a slightly projecting area which usually is nude, but which in two specimens bore a single seta.

Spermatophore (Fig. 23) elongate, oval, attenuated, and recurved at the anterior end.

Measurements of 10 males: Total length exclusive of setae, 0.592 mm (0.514–0.646 mm); greatest width (first thoracic segment), 0.092 mm (0.088–0.102 mm); length of caudal setae, 0.444 mm (0.411–0.480 mm).

Color in living specimens like that of the female.

Remarks.—Pholetiscus orientalis differs from the only other known species of the genus, *P. wilsoni* (Pearse), in the following respects:

FEMALE:

- Anterior antennae with eight podomeres instead of six.
- Presence of an exopodite on posterior antennae.
- Differences in setal arrangement on swimming legs 1–4 (compare the numerical tabulations in Tables 1 and 2).
- Two long terminal setae on caudal rami arise from common base instead of separately (compare Figs. 5 and 7).

MALE:

- Differences in armature of the endopodite of the third swimming leg (compare Figs. 4 and 21).

One female copepod was found in which all rami of the swimming legs were normal except the exopodite of the left third leg (Fig. 24) which had only two podomeres instead of three, with the setal arrangement 0, 0, and 5.

The number of small setae in groups on the thoracic legs is subject to variation, and for that reason it is doubted whether giving formulas of all setae, large and small, is particularly useful. Such variation exists, for example, in the number of setae along the inner margin of the first thoracic endopodite, which was found to vary from six to nine with the usual number of eight.

When the copepods were placed in a watch glass of sea water, they swam about actively, often in pairs, a male clasping the terminal setae of the caudal rami of a female by means of its anterior antennae.

The food of *P. orientalis* consists partly at

TABLE 3.—INCIDENCE OF PHOLETISCUS ORIENTALIS IN HOST CRABS AT TARAKAN, DUTCH BORNEO

Host crab	Number of specimens examined	Number positive	Number negative	Largest number found in any individual crab	Average number of copepods per positive crab
Sesarma eumolpe de Man:					
Females	24	20	4	27	5.4
Males	24	15	9	34	6.7
Total	48	35	13		6.0
Sesarma taeniolatum White:*					
Females	11	5	6	7	5.0
Males	13	5	8	7	3.4
Total	24	10	14		4.2
Grand total	72	45	27		5.0

* Included in this category are a few individuals of *Sesarma palawanense* Rathbun, not distinguished from *taeniolatum* at the time of collection.

least of diatoms of the *Pinnularia* type and blue-green algae, both of which were frequently observed in the alimentary tract of mounted specimens.

The incidence of *P. orientalis* in host crabs at Tarakan is shown in Table 3.

The crabs were collected in a marshy area a quarter of a mile west of the town of Tarakan, located on Tarakan Island in the delta region formed by the Sungei Sesayap. The marsh is periodically flooded by tidal water from Batagau Strait. Some crabs were found in water-filled depressions, others were running about on moist ground under debris of wooden shingles and rotting palm fronds.

In all three species of host crabs and in both sexes unidentified nematodes and diperous larvae were frequently found in the gill chambers along with the copepods.

DISCUSSION

The genus *Pholetiscus* mihi is related to *Cancrincola* Wilson, 1913, and both may be included in the family Canthocamptidae *sensu lato*. However, if the family is used in the restricted sense, as in Monard's synoptic work on the harpacticoids (1927), then it properly would include only *Pholetiscus*, *Cancrincola* being removed to the Ameiridae.

The two genera are well defined, both morphologically and geographically, *Cancrincola* being found in the Caribbean and Gulf of Mexico area, and *Pholetiscus* in Borneo and Japan. It seems probable that future investiga-

TABLE 4.—DISTINCTIVE CHARACTERS SEPARATING THE GENERA CANCRINCOLA AND PHOLETISCUS

	Character	*Cancrincola*	*Pholetiscus*
Females	Rami of legs 1–4	Endopodite of first with 2 podomeres; all others with 3.	Endopodites with 2 podomeres; exopodites with 3.
	Number of abdominal segments	4	3
	Number of aesthetasks	1 or 2	None
	Distal podomere of fifth leg	With 4 or 5 terminal setae.	With 2 terminal setae.
	Terminal setae on caudal ramus*	1 long curved seta plus other small ones.	1 long curved seta, another $\frac{1}{4}$–$\frac{1}{7}$ as long, plus other small ones.
	Mandibular palp*	Cylindrical, tipped with about 4 slender setae.	Reduced to only 1–3 small setae.
Males	Number of abdominal segments	4	4
	Anterior antennae	With 8 podomeres, moderately prehensile.	With 3–8 podomeres, strongly prehensile.
	Number of aesthetasks	1	None
	Rami of legs 1–4	Endopodite of first with 2 podomeres; all others with 3.	Endopodites of first, second, and fourth with 2 podomeres; endopodite of third with 3 podomeres; all exopodites with 3.

* True of male also.

tions will greatly increase the geographical range of these genera. Both genera occur in the gill chambers of marsh crabs, especially those of the genus *Sesarma*, commonly found in the vicinity of river deltas.

The two genera are readily separated by making the comparisons shown in Table 4.

The harpacticoid copepods at present known to inhabit the gill chambers of crabs comprise four species belonging to two distinct though related genera, namely, *Cancrincola jamaicensis* Wilson, 1913, *C. plumipes* Humes, 1941, *Pholetiscus wilsoni* (Pearse, 1930), and *P. orientalis* mihi. The two species of *Pholetiscus* may be distinguished from those of *Cancrincola* and from each other by the following key:

1. Female.....2
   Male.....4
2. Endopodite of first leg with 2 podomeres, all others with 3; distal podomere of fifth leg with 4 or 5 terminal setae.....*Cancrincola*
   Endopodites all with 2 podomeres; distal podomere of fifth leg with 2 terminal setae.....*Pholetiscus*....3
3. With exopodite on posterior antennae; 2 long terminal setae on caudal ramus arising from common base.....*P. orientalis*
   Without exopodite on posterior antennae; 2 long terminal setae on caudal ramus arising separately.....*P. wilsoni*
4. Endopodites of second, third, and fourth legs with 3 podomeres.....*Cancrincola*
   Endopodites of second and fourth legs with 2 podomeres, third with 3...*Pholetiscus*....5
5. Three stout spines near base of falciform projection on second podomere of third endopodite.....*P. orientalis*
   One minute spine near base of falciform projection on second podomere of third endopodite .....*P. wilsoni*

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PROCEEDINGS OF THE ACADEMY

408TH MEETING OF BOARD OF MANAGERS

The 408th meeting of the Board of Managers, held in the Cosmos Club, April 14, 1947, was called to order at 8 P.M. by the President, Dr. WALDO L. SCHMITT. Others present were: H. S. RAPPLEYE, F. M. SETZLER, W. N. FENTON, H. B. COLLINS, JR., W. W. DIEHL, J. S. WADE, L. E. YOCUM, W. A. DAYTON, M. A. MASON, A. O. FOSTER, C. L. GARNER, C. L. GAZIN, and, by invitation, G. P. WALTON.

The President announced the appointment of A. T. MCPHERSON and W. W. RUBEY to the Legislative Committee, authorized at the March 17 meeting of the Board, with Dr. MCPHERSON as Chairman. Additional appointments to this Committee are expected to be made in the near future.

The Chairman of the Meetings Committee, G. P. WALTON, announced that Prof. J. B. SUMNER, biochemist of Cornell University, had been scheduled to speak at the May meeting of the ACADEMY on the work for which he was recently awarded a Nobel Prize.

Ten persons were elected to membership in the ACADEMY.

The Chairman of the Anniversary Committee, F. M. SETZLER, reported an informal consideration of plans for celebrating the 50th anniversary of the founding of the ACADEMY. The date for such a celebration was discussed, and informal show of hands indicated a majority of the Board in favor of February 18, 1948. The desirability of holding a subscription dinner was discussed as one of the ways in which the anniversary might be observed.

The Treasurer, Mr. RAPPLEYE, announced an increase in returns from investments in the Washington Sanitary Improvement Co. He also announced that 30 new subscriptions for the JOURNAL had been obtained from Russian sources, with a possibility of 5 more.

The Senior Editor, Dr. FENTON, reported the prospect of devoting one issue of the JOURNAL to the three Academy Award winners for 1947.

The President presented his ideas on the desirability of appointing a historian for the ACADEMY, or a committee, to look into various past activities and in particular to ferret out any unconsummated actions indicated in the Board's past records.

The President also announced a Science Fair, organized by the teachers of the District of Columbia secondary schools and sponsored by the scientific societies of Washington, to be held during the week May 19 through May 23 in the Department of Commerce Building.

The meeting adjourned at 9:15 P.M.

NEW MEMBERS OF THE ACADEMY

There follows a list of persons elected to membership in the ACADEMY, by vote of its Board of Managers, since June, 1945, who have since qualified as members in accordance with the bylaws. The bases for election are stated with the names of the new members.

RESIDENT

Elected October 15, 1945

WILLIAM HARLEN GILBERT, Jr., anthropologist, Library of Congress, in recognition of his contributions to knowledge of social organization in studies of the Cherokee Indians and of the caste systems of India and Ceylon.

CHARLES LEWIS GORDON, chemist, National Bureau of Standards, in recognition of his contributions to methods of solution of refractory materials, particularly at elevated temperature and pressures, and to analytical procedures for such materials.

FRANK WILBUR SCHWAB, chemist, National Bureau of Standards, in recognition of his contributions to the chemistry of analytical reagents and pure substances, and to knowledge of the properties of benzoic acid which makes it possible to use the freezing temperature of this substance as a fixed point for precision resistance thermometry.

Elected November 9, 1945

HOMER G. BARNETT, anthropologist, Smithsonian Institution,[1] in recognition of his studies of the processes of cultural change, and of the ethnology of the Northwest Coast Indians.

SCOTT ELLSWORTH FORBUSH, physicist, Navy Department, in recognition of his contributions to geomagnetism, in particular for his investigations of cosmic radiation and its relation to geomagnetism.

VICTOR HICKS, physicist, Navy Department, in recognition of his services in the field of radiology; and his contributions during the war to the research program of the Bureau of Ordnance, Navy Department.

[1] Dr. Barnett has since returned to the University of Oregon.

Elected January 14, 1946

CHARLES J. CLIFFORD, mathematician, U. S. Coast and Geodetic Survey, in recognition of his work in the processing and analysis of geodetic-survey records particularly with reference to precision leveling and the study of earth movement as revealed by repeated levelings.

ROBERT C. DUNCAN, physicist, Naval Ordnance Laboratory, in recognition of his contributions to the development of under-water ordnance and naval warfare.

Elected February 18, 1946

EDWARD E. CLAYTON, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his contributions in the fields of vegetable diseases and tobacco diseases, especially disease resistance.

FREDERICK J. HERMANN, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his research work in American botany, particularly in the taxonomy and phytogeography of North American phanerogams, and more especially in the difficult genera *Juncus*, *Carex*, and *Astragalus* and in the family Leguminosae.

HENRY A. RUTHERFORD, chemist, Milton Harris Associates, in recognition of his contributions to the chemistry of fibers, in particular his work on the oxidation of wool and cellulose.

ROBERT SIMHA, chemist, National Bureau of Standards, in recognition of his contributions to the physical chemistry of high polymers and in particular his researches on the theories of viscosity, elasticity, and flow and the kinetics of polymerization.

BENNETT T. SIMMS, veterinarian, Bureau of Animal Industry, in recognition of his contribution to parasitology and infectious diseases of domestic animals, especially his solution of the problem of salmon poisoning of dogs in the Pacific Northwest.

BRUCE L. WILSON, physicist, National Bureau of Standards, in recognition of his work in improving methods for the calibration of dynamometers, strain gages, and machines for testing mechanical properties.

Elected May 13, 1946

DORIS H. BLAKE, entomologist, in recognition of her work on the taxonomy of beetles, particularly of the family Chrysomelidae.

HENRY W. HEMPLE, geodesist, U. S. Coast and Geodetic Survey, in recognition of his contributions to the science of practical geodesy

and in particular for his improvements in instrumental methods and the development of the horizontal survey nets of the United States.

HENRY A. JONES, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his contributions in the fields of horticulture and genetics, in particular the genetics of *Allium cepa*.

CLARENCE A. REED, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his contributions to horticulture, particularly his investigations in hybridization of nut trees.

FREDERICK J. STEVENSON, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of contributions in plant genetics, in particular his studies on inheritance of resistance to diseases in cereals and potatoes.

Elected December 16, 1946

BAILEY E. BROWN, botanist, Summers Fertilizer Co., Inc., Baltimore (resident of Washington), in recognition of his work on the fertilizer requirements of different soil types and especially on the fertilization of potatoes.

EDWARD U. CONDON, physicist, National Bureau of Standards, in recognition of his contributions to theoretical physics, particularly quantum mechanics.

ROMAN F. GELLER, ceramist, National Bureau of Standards, in recognition of his work on clays, pottery, insulators, and refractories.

ARTHUR E. RUARK, physicist, Applied Physics Laboratory, Johns Hopkins University, in recognition of his outstanding contributions in the field of physics.

MERLE A. TUVE, physicist, Department of Terrestrial Magnetism, Carnegie Institution of Washington, in recognition of his outstanding contributions in the field of physics.

Elected January 13, 1947

MYRON S. ANDERSON, chemist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his contributions in the field of soil chemistry, in particular of his researches on soil colloids.

J. F. GATES CLARKE, entomologist, Bureau of Entomology and Plant Quarantine, in recognition of his contributions on the taxonomy of the Microlepidoptera.

HERBERT G. DEIGNAN, biologist, U. S. National Museum, in recognition of his contributions to knowledge of the ornithology of southeastern Asia, especially Siam, on which subject he is the outstanding American authority.

JOSEPH A. EWAN, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his monographic studies of *Delphinium* and other important genera of vascular plants; his floristic investigation in California and Colorado with particular emphasis upon the correlation of the flora with geography; his bibliographic and historical essays; and his broad background and deep interest in the whole field of biology.

EARL D. FOWLER, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his work in soil investigations, survey, and classification.

GEORGE WASHINGTON IRVING, Jr., chemist, Bureau of Agricultural and Industrial Chemistry, in recognition of his work on pituitary hormones and extensive research on plant and animal enzymes and proteins.

RONALD MUNRO WILSON, engineer, U. S. Geological Survey, in recognition of his contributions to the art of surveying and in particular for his development of the photoalidade in plane table operations.

NONRESIDENT

Elected January 14, 1946

EDUARDO C. CABALLERO, entomologist, Instituto de Biología, Casa del Lago, Chapultepec, Mexico, in recognition of his contributions to knowledge of the helminth fauna of Mexico.

Elected February 18, 1946

FREDERICK K. SPARROW, botanist, University of Michigan, in recognition of his contributions on aquatic phycomycetes.

Elected January 13, 1947

NORMAN C. FASSETT, botanist, Harvard University, in recognition of his contributions to the knowledge of the flora of Wisconsin, his phylogeographic studies of the North American flora, especially of aquatic species, and his successful advocacy of the importance of mass collection in taxonomic researches.

LEWIS B. KELLUM, geologist, University of Michigan, in recognition of his contributions to the stratigraphy and structure of Mexico.

ALEXANDER HANCHETT SMITH, botanist, University Museums, University of Michigan, in recognition of his contributions to the taxonomy and cytology of the Agaricales.

C. L. GAZIN, *Secretary.*

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CULTURAL ANTHROPOLOGY.—*The expansion of the scope of science.*[1]

LESLIE A. WHITE, University of Michigan. (Communicated by G. R. WILLEY.)

"Anyone who is acquainted with the history of science will admit that its progress has, in all ages, meant, and now more than ever means, the extension of the province of what we call matter and causation, and the concomitant gradual banishment from all regions of human thought of what we call spirit and spontaneity."—T. H. HUXLEY.

* * *

When we survey the history of science we see at a glance that progress has not been equal and uniform on all fronts. Advance has been more rapid in some quarters than in others. Greater progress has been made in astronomy and physics than in biology; physiology is more advanced, as a science, than psychology; and psychology is older and more mature than sociology. The birth of each science can not be neatly marked with a precise date, of course; there has been overlapping, and growth has been simultaneous among many, if not all, of them. Nevertheless, it is clear that some sciences are older and more mature than others. Since there is a close correspondence between the age of a science and its degree of development, we may treat these two factors as one. We may thus arrange the sciences stratigraphically in the order of their respective ages and degrees of maturity:

"Social" sciences	Cultural anthropology Sociology Social psychology
Biological sciences	Psychology Physiology Anatomy
Physical sciences	Chemistry Physics Astronomy

Generalizing broadly, we may say that the physical sciences appeared earlier and have developed farther than the biological sciences; the biological sciences took form earlier and have developed farther than the social sciences. The question naturally arises, Why has this been so? Why do we find this order, both with regard to time and to degree of development, in the history of science?

One of the most noteworthy attempts to answer this question is that of Auguste Comte. In his *Positive philosophy*[2] Comte sets forth and explains the "hierarchy of the sciences." His arrangement is essentially the same as ours. He distinguishes, in order, "Five fundamental Sciences . . . Astronomy, Physics, Chemistry, Physiology, and finally Social Physics [i.e., Sociology]" (p. 46). But, instead of grouping the sciences into three categories, as we have done, he divides them into two: "inorganic physics," which includes astronomy, physics, and chemistry; and "organic physics," which embraces physiology and sociology (pp. 44–45). Although he does not distinguish "psychology" from "physiology," Comte deals with psychological phenomena in Book V: Biology.

Herbert Spencer, also, concerned himself with the development of science and with

[1] Received March 14, 1947. The epigraph is from a lecture by T. H. Huxley entitled "The Physical Basis of Life," delivered in Edinburgh in 1868; quoted from a reprinting in New Haven, Conn., 1870, pp. 30–31.

[2] This great work was published serially in Paris during the years 1830–1842. Our page references are to Harriet Martineau's translation, one-volume edition, Peter Eckler, Publisher, New York (no date).

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the classification, or order, of the sciences. In 1854, in an essay "On the Genesis of Science," he attacked Comte's theory of the sequence of the sciences. Spencer declares that "throughout the whole course of their evolution there has been a continuous *consensus* of the sciences."[3] He says:

> The conception of a *serial* arrangement of the sciences is a vicious one . . . the sciences cannot be rightly placed in any linear order whatever. . . . There is no "true *filiation* of the sciences." The whole hypothesis is fundamentally false.[4]

I am not sure that I fully understand Spencer's argument. Throughout this essay he exhibits science as the accumulating product of a many-sided psychological process. But with the possible exception of an allusion to "social science" in ancient times, he does not show, nor does he attempt to show, that the physical sciences have not matured earlier than the biological sciences, and these in turn earlier than the social sciences.

A decade later in "The Classification of the Sciences" (1864), Spencer again returns to the subject and again opposes Comte's hierarchy. But he ends up with an order essentially like Comte's. Lester F. Ward noted the similarity of Comte and Spencer at this point in his *Dynamic sociology*.[5] When, however, he repeated the observation in "The Place of Sociology among the Sciences,"[6] he received a sharp letter from Spencer who again insists upon his distinctness from Comte. Ward made effective reply to Spencer and published both letters in *Pure sociology*.[7] Ward again points out that despite his vigorous opposition to Comte, Spencer adopts the Comtean order of the sciences. In "The Filiation of the Sciences," a paper before the Philosophical Society of Washington in 1896, Ward exhibited the two systems, Comte's and Spencer's, in parallel columns for comparison.[8] They are fundamentally alike.

It would probably be unfair to say that Spencer's opposition to Comte's hierarchy was due wholly to a jealous claim to independence and originality on Spencer's part, although it is difficult to escape the conclusion that jealousy played a part in the controversy. It does appear that Spencer viewed the problem from a somewhat different angle than Comte, that he started from a slightly different premise. But nevertheless he ends up with much the same conclusion, and it is hard not to believe that it was willful stubbornness on Spencer's part that kept him from recognizing his similarity to Comte as well as pointing out such differences as did exist.

We find, then, that both Comte and Spencer present the sciences in essentially the same order, the physical sciences coming first, the biological sciences next, and finally the social sciences. Spencer points out that physical *phenomena* must precede biological phenomena—that there must be atoms and molecules before we can have living cells and organisms—and that social systems must rest upon a biological basis. But he does not explain why scientific *interpretation* of physical phenomena should precede interpretation of biological events, or why interpretation of biological forms should come before interpretation of social phenomena. Auguste Comte, however, does precisely this. He *explains* the order of development of the sciences. Let us turn now to his theory.

Comte's conception of the hierarchy of the sciences differs somewhat from ours. He does not begin with the events of history, with dates and sequences, and with varying degrees of development among the sciences, and then proceed to consider what interpretation might be given to these facts. Rather, he begins with the nature of the sciences, as he conceives it, and with what he assumes to be their necessary logical relationships one to another. The "hierarchy" of the sciences is arrived at by deduction. It is a "rational order" to Comte (p. 43). He observes, however, that his "classification agrees in the main with the

[3] "On the Genesis of Science," p. 143 (*Essays: Scientific, political, and speculative*, vol. I; London, 1868).

[4] *Ibid.*, p. 144; see also the conclusion of the essay, pp. 190–193.

[5] New York, 1883.

[6] Amer. Journ. Sociol. **1**: 16–27. 1895.

[7] Pp. 66–69; New York, 1903.

[8] A rather full account of Ward's paper, prepared by W. C. Winlock, secretary of the Philosophical Society, was published in Science **3**: 292–294. Feb. 21, 1896.

history of science; the more general and simple sciences actually occurring first and advancing best in human history, and being followed by the more complex and restricted" (p. 43). Thus, the general picture of the development of the sciences as seen by Comte is essentially the same as ours; the physical sciences appeared earlier and have developed farther than the biological sciences, as the latter have developed earlier and progressed farther than the social sciences.

Comte explains this chronological order and these varying degrees of development in this way: The physical sciences deal with simpler and more universal phenomena than the biological sciences; the biological sciences deal with more universal and simpler phenomena than the social sciences. Since biological phenomena are made up of chemical and physical events, a science of biology can not come into being until the sciences of chemistry and physics have been developed. Similarly, since social phenomena consist of, or are the expressions of, psychological responses, and these in turn rest upon physiological processes, a science of sociology can not be achieved until the underlying sciences of psychology and physiology have been developed. He says:

> . . . every science is [rooted] in the one which precedes it . . . (p. 398) . . . no science can be effectually pursued without the preparation of a competent knowledge of the anterior sciences on which it depends (p. 48). We must begin then with the study of the most general or simple phenomena, going on successively to the more particular or complex. This must be the most methodical way, for this order of generality or simplicity fixes the degree of facility in the study of phenomena, while it determines the necessary connection of the sciences by the successive dependence of their phenomena (p. 44).

We seem to have here three closely related propositions: first, that sciences higher in the hierarchy deal with more "complex" phenomena than sciences lower in the scale; secondly, that differences in degree of complexity have determined the order of emergence and degree of maturity of the sciences; and thirdly, that one can not "effectually pursue" a science "without the preparation of a competent knowledge of the anterior sciences on which it depends." We believe that these propositions are either unsound or definitely misleading. Let us examine them in turn.

In one sense, psychological phenomena may be regarded as more complex than those of physiology, as physiological events, in turn, may be considered more complex than chemical and physical events. By "complex" in these contexts we would mean "possessing more classes, or kinds, of factors." Thus, a psychological event, such as perceiving, approaching, and grasping food, can, by logical analysis, be reduced to physiological, chemical, and physical processes: smelling or seeing the food and the various physiological responses which find overt expression in approaching and seizing it; and the physiological processes may be broken down into chemical reactions and physical events. In this sense, the phenomena of one science may be said to be more "complex" than those of another. And in this sense, also, one may say that one science "rests upon" another.

While the foregoing is perfectly true logically and philosophically, it is beside the point scientifically. From the standpoint of the scientist, there is only *one* class of phenomena to be considered in any given situation. Even in biochemistry, which might appear to include two classes of phenomena, we really have only one class; the possibility of referring biochemical events to chemistry on the one hand and to biology on the other in no way negates the integrity of biochemical events *as biochemical phenomena*. Let us illustrate the distinctness of levels of phenomena and the integrity of the class of events corresponding to each level with an example:

I give my broker an order to buy 100 shares of stock. He telegraphs the order to the exchange in New York, a seller is found, and the transaction completed. We may distinguish many classes of phenomena involved in this transaction taken as a whole and in its entire extent and depth. First there are the psychological motives for buying and selling: desire, anticipation of gain, fear of loss, excitement of risk-taking, etc. Underneath are physiological processes: the condition of my thyroid, my digestion,

etc. And we can analyze the physiological processes into chemical reactions. Atomic motion, electrical tensions, and discharges in my nervous system, and so on, give us a class of physical factors. But, for an understanding of the transfer of the stock *as an event of buying-and-selling*, as a *social* event, the scientist need not and does not concern himself with all these kinds, or levels, of processes at all. The scientist *never* grapples with *all* the interrelated phenomena that confront him in a given situation. To do so would be to embrace the cosmos every time a sparrow falls. This is undesirable as well as impossible. The scientist must always abstract a certain segment of reality, a certain class of phenomena, from all others, and deal with it *as if* it existed by itself independent of the rest.[9]

Similarly the physiologist abstracts certain processes from the totality of reality and regards them as a closed system. Thus, the argument that the sciences higher in the hierarchy are more complex—i.e., consist of more classes of phenomena—than those on lower levels, is irrelevant from the standpoint of science, since the scientist deals with only one class at a time anyway. Socio-psychological phenomena, such as the purchase-and-sale of stock, may be treated as a single, homogeneous class of events despite the fact that physiological, chemical, electrical, and physical processes underlie it. In this respect psychology does not differ from physics.

Sociologists and cultural anthropologists are accustomed to account for the meagerness of their accomplishments, as compared with physicists or physiologists, by declaring that the phenomena with which they deal are so much more complex than the phenomena confronting the physicist or biologist.[10] They seldom explain what they mean by "complexity," and more rarely do they attempt to prove that complexity of phenomena must mean meagerness of scientific achievement. They merely assume, in the first place, that everyone knows what is meant by complexity, and, in the second place, they assume without argument that complexity means difficulty. We regard their reasoning as unsound. Social phenomena are no more complex in the sense of "difficult to treat scientifically" than physical or physiological phenomena. The social scientist's plea of "complexity" is usually an attempt, unconscious no doubt, to conceal his helplessness. The difference lies not in complexity of phenomena but in knowing what your problem is and how to attack it. The physicist knows what his problem is and how to go about solving it; the social scientist does not. And the reason for this is that the point of view and the techniques of science have been growing and maturing in the physical domain for centuries, whereas they were introduced into the social realm only yesterday. A science cannot be built in a year like a skyscraper. Indeed, it can not be *built* at all; it must *grow*, and this requires time.

We have already seen that the purchase-and-sale of stock is a very simple affair; it is no more complex than an apple falling to the ground. And, what is more, we probably know more about stock markets than we do about gravitation. A war between two nations is really a very simple thing at bottom: two nations, A and B, want the same thing—a fertile river valley, an oil-field, a foreign market, a seaport—and both are determined to have it. This is no more complex than the rusting of iron or the freezing of water. As a matter of fact, it may be simpler than the formation of ice or a snowflake. And it appears to be much simpler—simple in the sense of ease of scientific explanation—than matricide, masochism, or dementia praecox, events upon a *lower* level (psychological) than a war between nations (sociological level). We understand symbol behavior (e.g., articulate speech) much better on the psychological level than upon the lower level of neurology. We know more about the psy-

[9] "In all scientific procedure we begin by marking out a certain region or subject as the field of our investigations. To this we must confine our attention, leaving the rest of the universe out of account till we have completed the investigation in which we are engaged."—J. Clerk Maxwell, *Matter and motion*, p. 11 (New York, 1892).

[10] "The facts of society are far more complex than those of physics, hence no laws have hitherto been discovered."—R. H. Lowie, *Introduction to cultural anthropology*, p. 384 (New York, 1940).

chology of jealousy than its physiology. We understand the physiology of intoxication better than its chemistry, and the chemistry of glands better than their physics.[11]

As a matter of fact, one could make a good case for the exact opposite of the proposition that social scientists sometimes use to rationalize their shortcomings, and say that the complexity of phenomena and the difficulty of scientific interpretation increase rather than decrease as we descend the scale of the sciences. What is simpler than the purchase-and-sale of a share of stock? And what is more complex than a ray of light? Two hundred and twenty years have passed since the great Newton died and we do not yet know how to describe light. One might well argue that as we approach "ultimate reality" in physics the complexity of phenomena increases and the difficulties of scientific explanation become greater.

Complexity is a *quality* of a phenomenon, not a measure of its size. An atom is as complex as a molecule, a cell as complex as a cow. Nor is complexity a function of the level on which the phenomena are found except in the sense of resolving a class of events into subclasses as we have already noted. Complexity and simplicity obtain on all levels alike. So much for the concept of "complexity."

The third proposition, namely, Comte's contention that one can not "effectually pursue a science" until he has a "competent knowledge of the anterior sciences," has been taken care of fairly well in our treatment of the first two propositions. Who would wish to argue that one can not explain a transaction on the stock exchange until he had mastered physics and chemistry—or even the rudiments of those sciences? As we have previously pointed out, we often understand a phenomenon better on a higher level than upon a lower. Doris is jealous of Jane; Tom hates his father. We understand these events quite well psychologically; we know almost nothing about them on the physiological level. And, so far as we can see, anything that the physiologist might tell us would add little if anything to our understanding. And is the "chemistry," or "physics," of jealousy more than a metaphor?

We would reject, therefore, Comte's contention that preparation in sciences lower in the hierarchy must precede effective work in sciences higher in the scale. Since we have rejected Comte's premise that varying degrees of complexity have determined the order of filiation of the sciences, and since we admit differences in complexity only in so far as this term refers to the number of kinds of phenomena into which a situation can be analyzed, we have, in effect, rejected Comte's rationalization of his hierarchy almost *in toto*. In place of Comte's explanation of the order in which the various sciences have emerged and matured, we venture to propose the following theory:

Every living organism strives to evaluate the various items in its environment, to discover which are beneficial, which injurious, so that advantage may be derived from the one and injury from the latter avoided. In addition to the sensory means employed in this evaluating process by other animals, man employs verbal symbols. He not only translates the evaluations of his senses into words—"fire is hot," "thorns are sharp"—but he posits relational values between one thing and another. Thus he declares that the hoot of the owl presages death, a falling star means good luck, etc. In this manner, man creates a philosophy, a body of ideas and beliefs expressed in verbal form, which he employs as a means of adjustment to the world he lives in.[12]

From our standpoint of analysis and classification, there have been, and logically can be, only two major types of philosophy: one in which the external world is interpreted in terms of the human ego; the other in which it is explained in terms of *itself*. In the first type, man unconsciously projects himself into the external world, describing and interpreting it in terms of his own psychic processes. The whole world is thus made alive and peopled with spirits who feel and behave as men do. They have

[11] *Cf.*, WHITE, LESLIE A., "The Symbol: the Origin and Basis of Human Behavior," Philosophy of Science **7**: 451–463. Oct. 1940); reprinted in ETC, a Review of General Semantics **1**: 229–237. 1944.

[12] *Cf.*, WHITE, LESLIE A., "The Symbol: The Origin and Basis of Human Behavior."

desires like men, show preferences for certain foods and drink; they are susceptible to jealousy and flattery; they fight and make love. One spirit makes the earth, another brings rain, a third sends game or brings forth crops. The gods favor or oppose certain types of economic and political systems, and aid the armies of their chosen nations. Thus man creates the world in his own image. This is the philosophy of supernaturalism: of animism and anthropomorphism.

In the second type of philosophy, the phenomena of nature are explained in terms of themselves, in terms of the events of nature. Thus, rain falls because other meteorologic phenomena precede and accompany rainfall; a fossil is merely a link in a chain of paleontologic events. Explanation in this type of philosophy consists of a recitation of relevant events; scientific explanation is thus condensed description. This is the philosophy of naturalism.

Between these two major types, in the process of development of philosophy, lies an intermediate, or transitional type, which Comte has called "metaphysical." This may be illustrated by such statements as "fossils were produced by stone-making forces"; "opium puts one to sleep because of its dormative powers"; "cattle graze together because of a gregarious instinct."[13] This kind of interpretation partakes of both of the major types of philosophy. It eschews animism and points to the external world for its explanations. Thus it says that fossils are produced by stone-making forces—i.e., by natural phenomena that exist and function in the realm of nature—not by gods with minds like ours. But, the explanatory device, "stone-making forces," is merely a part of our selves, a verbal formula created *ad hoc*, and projected into the external world. *Functionally*, it is like the concept "spirit," and hence has affinity with the anthropomorphic philosophy of animism.

In the beginning of human history man's philosophies were wholly animistic; he diffused his psyche throughout the cosmos; he confused the self with the not-self at almost every point.[14] As culture advanced philosophy grew and matured. Little by little the animistic philosophy was outgrown and the naturalistic philosophy developed. But progress in philosophic interpretation was not uniform in all fields of experience; it was greater in some sectors than others. The distinction between the self and the not-self—i.e., explanation of natural phenomena in terms of natural events rather than in terms of the human ego disguised as gods and spirits—was made first in the realm of celestial phenomena. This was followed by the distinction in the field of terrestrial physical phenomena. Then it was made in the biological field—in anatomical, physiological, and psychological phenomena, and in that order. The distinction between the self and the not-self was achieved in astronomy and physics before it was made in physiology and psychology because it was *easier* of accomplishment in the former than in the latter. And it was easier because *the phenomena of astronomy and physics are more remote and less significant as determinants of human behavior than are the processes of physiology and psychology.*

Man gradually learned, through ages of observation and experience, that all things do not affect his life equally. Some things are immediate and exert a powerful influence upon him; others are remote and affect his life but little. It is significant to note that systematic observation of the stars was

[13] We occasionally find this kind of explanatory device used in cultural anthropology even today. Thus, R. H. Lowie says that "owing to the separatism of the natives, no large population was ever anciently brought under a common head" in Polynesia (*Introduction to cultural anthropology*, p. 293; New York, 1940). Radcliffe-Brown says that certain institutions "are the results of the action of sociological principles" ("The Social Organization of Australian Tribes," Oceania 1 (4): 429). Franz Boas finds certain cultural phenomena "due to a classificatory tendency" ("The Origin of Totemism," p. 323, in *Race, language and culture*, New York, 1940).

[14] "To the Omaha nothing is without life: the rock lives, so do the cloud, the tree, the animal. He projects his own consciousness upon all things, and ascribes to them experiences and characteristics with which he is familiar; there is to him something in common between all creatures and all natural forms, . . . this something he conceives of as akin to his own conscious being."—Alice C. Fletcher, "Wakonda," in *Handbook of American Indians*, Part 2 (Bur. Amer. Ethnol. Bull. 30. Washington, 1910).

begun under the belief that they exert a powerful influence upon man's daily life. Vestiges of this belief are still preserved in the names of the days of the week: Sun's day, Saturn's day, etc. And enough of this ancient belief still flourishes to make astrology a profitable business enterprise even today.[15]

But as mankind accumulated experience and compared one thing with another, he discovered that stars exert less influence upon his life than such terrestrial phenomena as those of climate, topography, flora, and fauna. At the same time, systematic observation of planets and stars revealed regularities and an order that fostered description in terms of natural law rather than divine caprice. Thus astronomy was lost to animism, won for naturalism.[16]

As observation was continued and experience accumulated, it was discovered that, intimate as man is with his habitat, and influential as it is upon his life, there is yet another class of determinants of behavior even more immediate and significant: the human body. The man, the ox, the snake, and the bird all dwell in the same environmental setting, but they behave very differently. The deer is swift, the squirrel climbs trees, the bird flies, because they have different kinds of bodily structure. An appreciation of this fact was the dawn of the science of anatomy.

Anatomy developed before physiology, not because the structure of the body is "simpler" than its functioning, but because it is easier to distinguish between one's self (one's *ego*) and one's arms and legs than between one's self and one's glandular processes. The body, unsophisticated man feels, is but a shell, the house in which the true self dwells. The ego and the body, he feels, are two different things.[17] The self that he regards in "self-respect" is in no way affected by the amputation of a limb. One may lose both legs, his teeth, and even his eyes, but his "self" remains untouched and unscathed.[18] But when glands flow hot in anger or in love, naïve man does not distinguish them from his ego; he identifies the process with himself.

Similarly, the science of physiology matured before psychology: it is easier to distinguish between the self and the not-self when dealing with physiological processes than with mental phenomena. We observe that a hungry man behaves one way, a well-filled man another. The effects of work and rest are obvious. Disposition is influenced by digestion. Profound changes in behavior can be effected by drugs and alcohol. But, unsophisticated man feels, there is a point beyond which outside forces can not go, boundaries which they can not cross. Deep within him, naïve man believes, is a citadel that is impregnable, a sanctuary inviolable. Here he lives—his real self, his essential character, his very soul. The "human spirit" or Will is free, he thinks, subject to no laws natural or physical. He sees himself as *subject* only; he is unable to regard the self as an *object*, as an event in the world of nature. The distinction between self and not-self at this point lies beyond his grasp and comprehension.

It was a great day for science when man became able to look upon mental processes as so many events in a world of nature, when, to use William James's fine phrase, minds could be studied "as *objects*, in a world of other objects."[19] The distinction between subject and object was made. But the fight for naturalism has not been wholly won yet. Mental life is still called "the human spirit" in many circles, and the soul and mind still walk hand in hand in psy-

[15] According to *Time* magazine for March 25, 1946, p. 23, there were 25,000 practicing astrologers in the United States at that time; the five leading astrological periodicals had a combined circulation of nearly 1,000,000; and one of the leading astrological manuals sold at least 1,000,000 copies of its 1945 issue for $1 a copy.

[16] See Henri Poincaré's fine essay on astronomy, the mother of science, in *The value of science*, chapter 6.

[17] It is not merely "unsophisticated man" who is sure that "mind" and "body" are two different things. Descartes, certainly one of the greatest minds of modern times, maintains that "it is certain that I [that is, "my mind, by which I am what I am"] is entirely and truly distinct from my body, and may exist without it," *Meditations*, No. VI.

[18] " . . . and although the whole mind seems to be united to the whole body, yet, when a foot, an arm, or any other part is cut off, I am conscious that nothing has been taken from my mind," *idem*.

[19] *Principles of psychology*, vol. 1, Chapter 7.

chologies, sociologies, and anthropologies even today.

Thus we find the reason for the order in which the sciences have made their appearance and the extent to which they have matured to consist, not in varying degrees of universality or complexity, but in the varying ability of mankind to distinguish between the self and the not-self in various sectors of experience. This distinction is made most easily when one deals with phenomena which play an insignificant role as determinants of human behavior. Conversely, it is difficult to distinguish between the self and the not-self where phenomena are intimate and powerful determinants. The human race has discovered which are the powerful determinants and which the insignificant through experience; there was no *a priori* way of knowing.

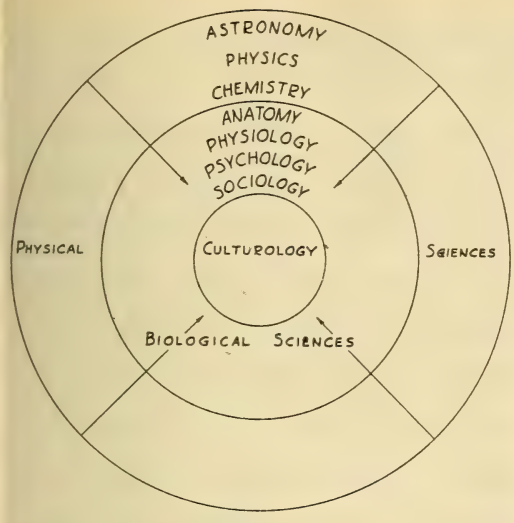
The heavenly bodies being more remote and less significant as determinants of human behavior than the winds, rain, frost, and terrain, the science of astronomy appears earlier and matures faster than terrestrial physics, geology, and geography. Anatomical determinants being more remote and less influential than physiological processes, the science of anatomy precedes physiology. Physiology comes before psychology for the same reason. We may conclude our argument by formulating the following law of development: *Science emerges first and matures fastest in fields where the determinants of human behavior are weakest and most remote; conversely, science appears latest and matures slowest in those portions of our experience where the most intimate and powerful determinants of our behavior are found.*

Auguste Comte recognizes this law when he observes:

> It is worthy of remark in this place that the most general and simple phenomena are the furthest removed from Man's ordinary sphere, and must [it would be better to say "can," L.A.W.] thereby be studied in a calmer and more rational frame of mind than those in which he is more nearly implicated; and this constitutes a new ground for the corresponding sciences being developed more rapidly (p. 44).

In explaining the "hierarchy of the sciences," however, Comte speaks of this "new ground" merely incidentally and in passing, while the argument based upon "the universal and the simple as opposed to the special and complex" is emphasized again and again. But in other portions of *Positive philosophy,* Comte takes pains to point out repeatedly that the obstacles that oppose the growth of social science are the theological and metaphysical philosophies, which must be driven from the field of social phenomena before a genuine social science can be achieved. Although we reject Comte's own explanation of the order of filiation of the sciences, we could, and indeed have, applied his theory of the three stages in the development of philosophy to the solution of this problem. What we have done, in effect, is to show that the "theological" (supernaturalistic) philosophy has been dislodged and driven first, and to the greatest extent, from interpretations of physical phenomena, next from biological studies, and last and to the least extent from explanations of human behavior. And, with the rejection of the theological philosophy and the decline of the metaphysical, there has been a growth and spread, *pari passu,* of the naturalistic, scientific philosophy. Thus, what we observe is a trend in philosophy from the theological through the metaphysical to the positivistic—from the supernaturalistic to the naturalistic, or scientific—sweeping across the field of experience from the physical through the biological to the social. Comte had all the materials for this explanation of his hierarchy, and indeed, it is implicit in the *Positive philosophy.* But so concerned is he with another rationalization that the true solution is all but obscured entirely.

We may illustrate the development and the sequence of the sciences in the accompanying diagram. In the center of the circle is man, surrounded by events which influence his behavior in varying degrees, some intimate, some remote. From this point of view, the advance of science has been more in the nature of expansion of scope than of growth or development. The cosmos lies everywhere about man. Science, a particular way of dealing with experience, appeared first in interpretations of a particular portion of our field of experience, namely, in astronomy, where phenomena are most re-



mote and insignificant as determinants of human behavior. From there its techniques have spread and extended to other segments of experience. As science advances and expands, the anthropomorphic philosophy of animism recedes and contracts; as the concepts of natural law and determinism gain ground, the philosophy of free will retreats. The logical conclusion is, of course, to have the whole field of human experience embraced by the philosophy of science rather than that of animism. It is interesting, in this connection, to recall the words of the eminent Polish sociologist Ludwig Gumplowicz, written many years ago:[20]

> Modern natural science has successfully demonstrated that even the "human mind" is subject to physical laws. . . . But in the domain of social phenomena unchangeable natural laws have not been completely demonstrated. Between "mental" phenomena subject to the laws of matter and the social world strode the conception of human freedom to distract and confuse. It seemed to order and control social relations according to its own choice. In the domain of mental phenomena . . . monistic natural science has in part demonstrated the unconditioned sway of natural laws. . . . Dualism [i.e., law vs. free will], *driven from this domain, has retired to the domain of social phenomena, whence it must be dislodged*" (emphasis ours).

We find the same view expressed by the great French social scientist, Emile Durkheim:[21]

> Since the law of causality has been verified in the other realms of nature, and since it has progressively extended its authority from the physicochemical world to the biological, and from the latter to the psychological, we are justified in claiming that it is equally true of the social world; and it is possible to add today that the researches undertaken on the basis of this postulate tend to confirm it (p. 141). There was a time when sentiments relating to the things of the physical world opposed with equal energy the establishment of the physical sciences, because they, too, had a religious or moral character. We believe, therefore, that this prejudice, pursued from one science to the next, will finally disappear also from its last retreat, sociology, leaving a free field for the true scientific endeavor (p. 34).

According to Comte, Spencer, and others since their day, sociology is the last link in the logical chain of science, the final stage of its development. In terms of our theory, this would mean that when astronomical, geological, physical, chemical, anatomical, physiological, and psychological determinants of human behavior had been dealt with there would remain but one more class of determinants: the sociological. But are we willing to accept this conclusion? Is this classification adequate and final? We do not believe it is. On the contrary, we find it inadequate and immature. There is still another class of determinants of human behavior, which lie outside and beyond the scope of psychology and, for the most part, sociology. These are the traditional customs, institutions, tools, philosophies, languages, etc., which we call, collectively, *culture*. Cultural phenomena are super-, or supra-, psychological determinants of human behavior. They are super-psychological in the sense that it is beyond the scope of psychology to account for them. Psychology can not explain, e.g., why one people has clans (behaves "clanwise") while another does not; why one people eats with knives and forks, another with chopsticks; why a people prohibits marriage between parallel cousins but requires marriage between cross cousins; why a tribe practices polyandry, observes the mother-in-law taboo, forms plurals by affixation, uses money, etc. Culture *as culture* can be explained only in terms of culture. But let us return to the history of science and observe its expansion beyond the horizons of individual psychology.

[20] *Outlines of sociology*, p. 74 (English translation, Philadelphia, 1899).
[21] *The rules of sociological method* (Chicago, 1938).

For a long time, and until recent decades, psychology was *individual* psychology. The anatomical and physiological psychologists had, of necessity, to take the individual as their province. The same was true of the introspectionists and associationists. In the early years, the subject matter of psychology was "mind," and the mind was something that "went on" in the individual organism. It was to be studied in terms of anatomical structure and physiological processes and by direct observation through introspection. In any event, psychology was the study of mind, and the mind was an individualistic phenomenon.

But as the scientific study of man's behavior advanced it came to be recognized that there are important determinants of behavior lying outside and beyond the individual which, however, profoundly influence his conduct. With the appreciation of this fact, science undertook to grapple with these superindividual determinants and to bring them within the scope of scientific interpretation.

Professional psychologists were, however, slow to appreciate the significance of superindividual determinants of human behavior. Consequently science organized its forces under another banner, so to speak, to undertake this necessary task. This new movement was Sociology.[22] Sociology came into being as an organized attempt of science to deal with superindividual determinants of behavior. These determinants were social in nature. Consequently, sociology became the science of society. Early sociologists distinguished their science from psychology on the ground that the latter was limited to the individual whereas theirs was devoted to the group. As F. H. Giddings put it:[23]

> . . . psychology [is] the study of the . . . individual mind . . . ; sociology . . . the investigation of the more special and complex phenomena of minds in association with one another. . . . Psychology is the science of the association of ideas. Sociology is the science of the association of minds.

Psychology bestirred itself meanwhile and gradually extended its scope to include superindividual determinants. William James displayed a fine appreciation of social factors in behavior in the chapter "The Consciousness of Self" in his *Principles of psychology* (1890). In 1904, at the Congress of Arts and Sciences at St. Louis, James McKeen Cattell stated that he was "not convinced that psychology should be limited to the study of consciousness as such."[24] And at the same Congress, J. M. Baldwin predicted that "the psychology of the future will be social to the core."[25] In 1908 William McDougall published his *Social psychology*. This was the first work bearing this title written by a psychologist. It so happened that E. A. Ross's *Social psychology*, the first work bearing this title by a sociologist, was published in the same year.

Although psychology was able to expand its horizons sufficiently to take cognizance of group factors in behavior, it still remained anchored to the individual as the object of its studies. Thus G. F. Stout and C. A. Mace, in their article "Psychology" in the Encyclopedia Britannica (14th ed.), declare that psychology is the "science of individual experience." And other psychologists even maintain that *social* psychology is after all a study of the individual. Thus F. H. Allport defines social psychology as "the science which studies the behavior of the individual" in so far as his behavior is related to that of other individuals. "Psychology in all its branches," he argues, "is a science of the individual."[26] Similarly, Prof. Margaret Floy Washburn declares that "all psychology deals with individuals." Social psychology, she says, is "that branch of psychology which deals with the mind as it is affected by and manifested in relations with other

[22] "Precisely because the currents of thought ran too exclusively to analysis and explanation in terms of the *single* human being, Sociology arose as a discipline for the study of the *collective* life of man. In the early years it was considered as properly beginning at the point where Psychology left off."—E. E. Eubank, *The concepts of sociology*, p. 90 (1932).

[23] *The principles of sociology*, pp. 24, 25 (New York, 1896; 1921 printing).

[24] "Conceptions and Methods of Psychology," p. 597 (Proceedings of the Congress, vol. 5, Boston, 1906).

[25] "The History of Psychology," p. 621 (Proceedings of the Congress, vol. 5).

[26] *Social psychology*, pp. 12, 4 (1924).

minds."[27] Thus psychology was able to reach out and at least take cognizance of social factors in behavior. But it was so firmly anchored to the individual as its object of study that it was unable to free itself and envisage a psychological *system* composed of many individuals instead of only one, a *social* organism as well as a biological one. This field was left therefore pretty much to the sociologists.

Sociology embarked upon its career with high hopes and enthusiasm. Psychology had long devoted itself to the individual aspect of human behavior. Now sociology was to deal with the group aspect. Give sociology time to mature, many thought, and the science of human behavior would be complete, for with the individual and collective aspects of behavior taken care of what else was there? To many sociologists of the late 1890's and early 1900's it appeared, as it had to Comte many decades earlier, that at last the "hierarchy" of the sciences was complete, that sociology was to be the crown or capstone of the great edifice that was science. But these hopes and aspirations have not been realized. Sociology has not become the head of an impressive hierarchy of sciences. On the contrary, many scholars, both within sociology and outside, raise the question, Is sociology a science at all? Whatever accomplishments sociology does have to its credit, it certainly has failed to fulfill the hopes and expectations of Comte and subsequent generations of sociologists. The reasons, we believe, are as follows:

Beyond the horizon of individual psychology lie not only superindividual psychological determinants of behavior, but superpsychological determinants as well. Sociology devoted itself to the interpretation of superindividual (i.e., social) psychological determinants of behavior, and in so doing became social psychology. But, with few and relatively insignificant exceptions, it failed to distinguish and to recognize superpsychological (i.e., cultural) determinants, and thus failed to complete the science of human behavior by becoming a science of culture (i.e., culturology). In short, sociology merely rounded out the science of psychology by making it the study of the collective aspect of behavior as well as of the individual aspect. But it failed to create or become a science of culture and thus left the science of human behavior incomplete. Another science beyond the horizon of sociology still remained to be realized, namely the science of culture (culturology). Before proceeding further let us see precisely what this class of superpsychological (cultural) determinants of behavior consists of, and what the nature and scope of a science of culture would be.

We may illustrate with the following example: a number of Navaho Indians were spending the night in a large house near their reservation when a party of other Navahos approached. Word of their approach was passed through the house whereupon a number of men quickly left by the back door and windows: their mothers-in-law were in the approaching group and they must not meet them face to face. How is their behavior to be explained?

Clearly there is a psychological reason for their behavior, and there are both individual and social aspects to their response. Each individual was influenced by his own organism and the experiences that it had undergone. And each individual was influenced by his fellow Navahos. The psychologist can properly deal with both aspects, the individual and the social, of this phenomenon. He can inquire into their feelings, ideas, and so on, and throw much light upon the matter. But there is a point beyond which the psychologist can not go: He can not explain why the Navahos observe the mother-in-law taboo whereas their close neighbors, the Hopi, do not. No amount of psychologizing will explain why one tribe has this custom while another does not. The psychologist does not always realize this. Sometimes he declares that the institution exists because the people think and feel and act in a certain way; that the institution is merely the crystallization of certain psychological processes. He fails to realize that it is the other way around: the people feel, think, and act the way they do because they possess—or, more accurately, are pos-

[27] "Social Psychology," in Encyclopedia Americana.

sessed by—a certain custom.[28] Manifestly, the psychologist can not explain why the Indian organism in the Navaho tribe behaves in such a way as to produce the mother-in-law taboo while the Indian organism in the Hopi tribe does not behave in that manner.[29]

If, therefore, psychology can not explain why one tribe has a certain custom while another people does not, what science can? The answer is, the Science of Culture. A custom or institution is the product of the action and interaction of other customs and institutions. The mother-in-law taboo would have to be explained in terms of *other customs*—those of marriage, residence, sexual division of labor, mode of subsistence, and so on. Customs and institutions—culture traits in general—constitute a distinct class of phenomena. As such, it may be treated as a closed system. Culture is a thing *sui generis;* culture *as culture* can be explained only in terms of culture.[30] Let us illustrate with a few other examples.

Psychology can not explain why the language of one people is agglutinative while that of another is inflective. This linguistic difference must be explained in terms of language, not in terms of mental processes or emotional states. Likewise, the psychologist can not explain why a people practices polygyny rather than polyandry or monogamy; why it resorts to legal trial rather than to ordeals or covert black magic in the case of personal injury; or why it fights over money and debts instead of practicing communism.

Thus we see that over and above the individual and social psychological factor in human behavior, there is another factor that is not psychological at all. It is super-psychological or cultural. In addition to the individual organic component in human behavior and over and above the social factor that comes from the interaction of individuals, there is the influence of the traditional customs, institutions, tools, philosophies, etc. These things,[31] these culture traits, have an existence prior to the birth of any person living. They exist outside the human organism; they act upon him from the outside as meteorologic forces do.[32] Culture can be transferred freely, without migration, from one people to another. The culture of any people at any given time is the product of antecedent cultural forces, and consequently is to be explained only in cultural terms. The English language of New England in 1947 is to be explained in terms of antecedent linguistic processes and events, just as the automobile, paper currency, courts of law, Mormonism, relativity, and jazz music are to be explained in terms of their respective cultural antecedents.

We see, then, that in addition to the psychological factor, individual and social, in human behavior there is an important suprapsychological factor. The importance of this factor has only recently come to be recognized and appreciated. Everything that we do as human beings, individually and collectively, is profoundly influenced by our culture. Our food habits, marital customs, ideas of right and wrong, canons of beauty, mortuary practices, our philosophies and religions, in short, the whole gamut of our lives, is culturally determined. And, far from explaining our culture in terms of the way we think, feel, and act, we can explain much of our thought, feelings, and behavior in terms of our culture.

This is not to say that there is no further function for psychology in the modern

[28] If "we see in the organization of the family the logically necessary expression of human sentiments inherent in every conscience [mind], we are reversing the true order of facts. On the contrary, it is the social organization of the relationships of kinship which has determined the respective sentiments of parents and children. . . ."—DURKHEIM, *The division of labor in society*, p. 349 (English translation; 1933).

[29] "Every time that a social [cultural] phenomenon is directly explained by a psychological phenomenon, we may be sure that the explanation is false."—DURKHEIM, *The rules of sociological method*, p. 104 (Chicago, 1938).

[30] "Culture is a thing *sui generis* which can be explained only in terms of itself."—R. H. LOWIE, *Culture and ethnology*, p. 66 (New York, 1917).

[31] DURKHEIM calls "social facts" (i.e., culture traits) *things* (*choses*). "The proposition which states that social facts are to be treated as things," he says, lies "at the very basis of our method" (*The rules of sociological method*, p. xliii).

[32] "Collective tendencies [i.e., culture traits] have an existence of their own; they are forces as real as cosmic forces . . . they also act upon the individual from the outside. . . ." —Translated from DURKHEIM, *Le suicide*, p. 348 (Paris, 1897).

science of human behavior. It will be noted above that we have said that "much," not "all," of our behavior can be explained culturally. There is still a place for psychology, of course. But its scope is not so extensive as was formerly supposed. The day of facile psychological explanations of customs and institutions is done. In the future, culture will have to be explained culturologically. But within any given cultural situation the operation of the psychological factors will still have to be observed and interpreted. For example, given Navaho culture, how will Indian organisms behave? In short, we can hold the cultural factor constant while we study the variable psychological factor.

Returning again to the history of science, we note that sociology was the new form taken by science in the extension of its scope to embrace superindividual determinants of behavior. Sociology became, for the most part, social psychology, and *social* psychology is of course psychology, just as ripe plums are plums, or honest men, men. But in going beyond the scope of individual determinants, sociology encountered superpsychological (cultural) determinants as well as superindividual psychological factors. But instead of dealing with cultural determinants upon their own level, i.e., culturologically, sociology brought them down to the sociopsychological level and attempted to interpret them in terms of "social process," or "interaction." Sociologists failed for the most part to realize that there is no such thing as social interaction among human beings *as* human beings (i.e., as organisms behaving in terms of symbols) that is not culturally determined. To say that social interaction produces matrilineal clans here, patrilineal clans there does not make sense. To say that one kind of process of interaction produces matrilineal, another kind of process patrilineal, clans is to put the cart before the horse. It is the type of clan, the culture trait, that determines the form of social interaction; matrilineal clans will produce one type of interaction, patrilineal clans another. And clans, as culture traits, can not be accounted for in terms of individual psychological processes—hopes, desires, fears, etc.—or in terms of an abstract process of social interaction but in terms of other culture traits, such as customary division of labor between the sexes which in turn is closely related to the mode of subsistence and the circumstances and means of defense against enemies; such as rules of marriage, place of residence of the married couple, and so on. And so it is with social interaction everywhere in human society. Whether it be in the family, clan, or lineage, household or neighborhood, guild, lodge, church, market place, or what not, the concrete processes of interaction that actually obtain in any given case have been determined, i.e., given form and content, by the culture that possesses the people, the culture that existed before they were born and into which they were introduced at birth, and which has given form and content to their behavior since that time. The attempt of sociologists to explain culture in terms of "social process" or "interaction" failed as of course it must. A sociological interpretation of culture does not and can not give a scientific account of the origin and function of customs and institutions; it merely conceals their suprapsychological, suprasociological, nature. Thus we see that when science created sociology in its march of expansion, it rounded out the science of psychology but failed to achieve a science of culture. Let us examine more fully the preceding propositions in turn.

The behavior of every living organism presents two aspects: inner and outer.[33] There are processes and relationships that take place within the organism; these we may call intraorganismal. Then there are reactions and relationships between the organism and the external world; these may be designated extraorganismal. We may define physiology as the scientific observation and interpretation of intraorganismal processes and relationships; psychology, as the study of the extraorganismal aspect of

[33] "All relations or actions between one part of . . . [a material system] and another are called Internal relations or actions. Those between the whole or any part of the system, and bodies not included in the system, are called External relations or actions."—J. CLERK MAXWELL, *Matter and motion*, pp. 11–12 (New York, 1892).

behavior.[34] Now extraorganismal behavior presents two aspects, individual and collective, and consequently can be studied from these two standpoints. In other words, we can have individual psychology and social psychology. But both are, of course, psychology—the scientific observation and interpretation of extraorganismal reactions. There is no such thing as an individual apart from the group, and no collectivity independent of individuals. *Individual* and *society* are but two poles of the same phenomenon: extraorganismal reactions of biological organisms.

When sociology took form as a distinct discipline it was dedicated, as we have seen, to the study of the collective aspect of behavior. It thus became social psychology. Because the psychology of that day was individualistic in character and outlook, the infant sociology took pains to distinguish itself from that science. It protested, for example, against being classed with the "mental sciences" in the program of the St. Louis Congress of Arts and Sciences.[35] Notwithstanding all this, numerous sociologists have testified that the subject matter of sociology is "mental phenomena" and that sociology is, for the most part, social psychology. Thus Lester Ward speaks of "that collective psychology which constitutes so nearly the whole of sociology."[36] Giddings declares that "society [is to be regarded] as a mode of mental activity . . . social life . . . is a phenomenon of the mind . . . common mental activity . . . ."[37] Accordingly, he regards sociology as "a psychological science."[38] Hobhouse says that "fundamentally society is a psychological structure."[39] American sociologists came to recognize that "social life is essentially psychical," according to Gottfried Salomon.[40] At the St. Louis Congress of Arts and Sciences, C. A. Ellwood speaks of social psychology as "this most important part of sociology."[41] Albion W. Small once defined sociology as "the science of the social process," but he also states that the interpretation of the social process is "social psychology."[42] Thus, sociology and social psychology appear to be one and the same. To Giddings "societal psychology is substantially the same thing as sociology."[43] And quite recently L. L. Bernard has declared that "modern sociology becomes largely social psychology."[44]

Thus sociology turns out to be social psychology, and social psychology is psychology, according to the testimony of sociologists as well as by our own definitions. E. A. Ross, the first sociologist to write a book entitled *Social psychology*, defined social psychology as a subdivision of "general psychology."[45] And more recently R. M. MacIver observes that "social psychology is a branch of psychology."[46] We note therefore that in so far as sociology is the study of social interaction, social process, etc., it is merely a psychological science. But what of the study of super-psychological determinants of behavior? Where does sociology stand with reference to interpretation of cultural phenomena?

Sociology was a quarter of a century old, if not more, before the concept of *culture* entered into its thinking to any appreciable extent. By degrees, however, the concept of culture—or, at least, the term—has become more common, and even popular. But, with few and relatively insignificant exceptions, sociologists have not been able to rise to a culturological point of view; they have not been able to envisage a science of culture as distinct from a science of society.

[34] Herbert Spencer, too, distinguished physiology from psychology in terms of "internal relations" and "external relations," "The Classification of the Sciences," Table 3.

[35] See the remarks of Prof. F. W. Blackmar as chairman of the session on Sociology (Proceedings of the Congress, vol. 5, p. 786).

[36] *Pure sociology*, p. 59 (New York, 1903).

[37] "The Concepts and Methods of Sociology," Proc. Congr. Arts and Sci. St. Louis 5: 788, 794.

[38] Preface to *Principles of sociology*, written 1896.

[39] *Social development*, p. 130 (London, 1924).

[40] "Social Organism," in Encyclopedia of the Social Sciences.

[41] Remarks as chairman of the section on social psychology, Proceedings 5: 859.

[42] *General sociology*, pp. 35, 622 (Chicago, 1905).

[43] *Civilization and society*, p. 402 (New York, 1932).

[44] "Sociology and Psychology," p. 348, in *The Social Sciences and their Interrelations*, Wm. F. Ogburn and Alex. Goldenweiser, editors (New York, 1927).

[45] "The Present Problems of Social Psychology," Proc. Congr. Arts and Sci. St. Louis, 5: 869.

[46] *Society: A textbook of sociology*, p. vii (New York, 1937).

To most sociologists culture is merely behavior, a particular kind of behavior, perhaps, but the reactions and interactions of human organisms, nevertheless. Thus Kimball Young says that "culture consists of . . . learned behavior patterns."[47] To Read Bain, "culture is all behavior mediated by social symbols . . . all culture patterns are resident in the organisms of persons."[48] Ogburn and Nimkoff say that culture is "behavior transmitted by learning."[49] Ellwood defines culture as "behavior patterns socially acquired and socially transmitted by means of symbols."[50]

There is also a tendency among sociologists to regard culture as merely a by-product of social interaction. Thus, E. R. Groves states that "culture is a product of human association."[51] Kimball Young thinks of culture as "a precipitate of man's social life."[52]

To many sociologists, "cultural" has become merely another word for "social." Robert S. Lynd, for example, speaks of "the individual in our culture," "leaders of the culture," etc.[53] As Jessie Bernard shrewdly observed many years ago, " 'culture' bids well to supersede 'society' and 'cultural,' 'social,' in the sociologist's vocabulary."[54]

The inability of sociologists to conceive of culture as a suprapsychological order, distinct from the process of "social interaction," is well exemplified by the eminent German sociologist Georg Simmel. When one considers, he says, "the development and character of language, morals, church, law, political and social organization," the conception that they constitute "a structure of independent reality, which leads its life after peculiar laws and by virtue of peculiar forces, independent of all its individual components" seems "inevitable."[55] Simmel is here face to face with culture. Its independence of individuals is so plain that it compels recognition by itself. That culture has an existence of its own which is determined by its own laws, is also so plain as to make the conception "inevitable." Yet, so mired in individualistic psychology is Simmel, and so blinded by an obsolete metaphysics, that he cannot accept the conclusion to which his observations and reasoning "inevitably" lead him. "It is certain," he stubbornly maintains, "that in the last analysis only individuals exist."[56] Even society exists only "in mental attitudes or psychological occurrences within the minds of individuals."[57] And culture, apart from material things, consists of "spiritual structures . . . [which] have their existence only in personal minds. Every attempt to think of them outside of persons is a mysticism. . . ."[58]

The conception of a science of culture held by many American sociologists is expressed by Dorothy P. Gary in her essay "The Developing Study of Culture":[59] "A science of culture will be built up only when the analysis of culture is approached from the standpoint that culture itself is a social process growing out of and consisting of collective human behavior." In other words, a science of culture will be realized only when it becomes a science of social process, of collective behavior, rather than a science of culture. Th. Abel considers the question of a science of culture in his essay, "Is a Cultural Sociology Possible?"[60] and comes to the conclusion that it is not. To Abel, sociology is the study of "interhuman be-

[47] *An introduction to sociology*, p. 19 (1934).

[48] "A Definition of Culture," p. 87 (Sociology and Social Res. **27**: 87–94. 1942), and "Trends in American Sociological Theory," p. 110 (in *Trends in American sociology*, G. A. LUNDBERG, et al., editors; New York, 1929).

[49] WM. F. OGBURN and MEYER F. NIMKOFF, *Sociology*, p. 63 (1940).

[50] "Culture and Human Society," p. 6 (Social Forces **23**: 6–15. Oct. 1944).

[51] *Introduction to sociology*, p. 23 (1928). See also E. R. GROVES and H. E. MOORE, *Introduction to sociology*, pp. 13–14 (1940), for a similar expression.

[52] *Sociology, a study of society and culture*, p. 36 (1942).

[53] *Knowledge for what?*, pp. 72, 186, and elsewhere (Princeton, 1939).

[54] "History and Prospects of Sociology," p. 68, in *Trends in American sociology*, G. A. LUNDBERG et al., editors (1929).

[55] "The Persistence of Social Groups," p. 665 (Amer. Journ. Sociol. **3**).

[56] *Idem.*

[57] N. J. SPYKMAN, *The social theory of Georg Simmel*, p. 27 (Chicago, 1925).

[58] "The Persistence of Social Groups," p. 665.

[59] In *Trends in American sociology*, G. A. Lundberg et al., editors, p. 182 (1929).

[60] Amer. Journ. Sociol. **35**: 739–52. 1929.

havior" of which culture is but an aspect.

There have been, to be sure, sociologists who have a fine appreciation of the role of culture in human behavior. Prof. C. A. Ellwood, for example, declares that "it is impossible to understand human society without understanding human culture; for the social behavior of man . . . is dominated by the culture of his group."[61] But he, too, thinks of culture as human (organic) behavior rather than as a class of suprapsychologic, superorganic, phenomena. To Ellwood, "all culture is a product of the human mind [which means that] back of all historical interpretation, therefore, must be the method of psychological analysis . . . the development of culture is essentially a learning process."[62] William F. Ogburn took a culturological point of view, to a certain extent at least, in his *Social change*. But, as we have just seen, he and his collaborator, Nimkoff, think of culture as human behavior. Malcolm M. Willey is another sociologist who has done much to bring his science to an appreciation of culture. He has gone so far as to declare that "the study of culture—the processes of its origin and its growth, its spread and its perpetuation—constitutes the study of sociology."[63] But in an earlier article written by Willey and Melville J. Herskovits (an anthropologist), we are told that "it must not be assumed, of course, that culture is a metaphysical entity which operates of itself. It is, rather, a generic term that covers an amazing number of types of behavior."[64]

Thus we see that sociologists think of culture as behavior, as social process or interaction, as a factor in human behavior, or as a by-product of human behavior. But they seldom, if ever, rise to the level of viewing culture as a distinct and separate class of suprapsychological, suprasocial phenomena; as a process *sui generis* with its own laws. In short, they can not rise above a science of society and envisage a science of culture. This is not, however, surprising. Being sociologists, they are by definition and tradition devoted to the study of society, of social interaction. It is not surprising, therefore, to find that when they are confronted with *culture* they translate it into the only language they know: the idiom of social interaction. There is not a single sociologist that we know of (Durkheim excepted) who has a clear conception of what a science of culture would be and who has devoted himself to the advancement of such a science.

A few sociologists have, however, been sufficiently exposed to the culturological point of view to be disturbed by it. Prof. R. M. MacIver is concerned with the "disturbing effect" which "the impact of anthropology" has had upon sociology; the "cultural approach," he says, "leaves sociology without a focus."[65] Prof. Robert S. Lynd[66] issues a clear warning against the error of "viewing culture as a self-contained force, operating by inner laws of its own." He lists "four distinct advantages" which may be gained from treating culture as human behavior instead of as culture ("basically impersonal things"). Culture, he argues, does not "enamel its fingernails, or vote, or believe in capitalism, but people do." L. L. Bernard,[67] too, argues against a science of culture, denying that culture is a thing *sui generis*. He likewise thinks of culture as "the impact of an intelligent organism . . . upon its environment," in other words, as the reactions of the human organism.

Thus, among sociologists we find a recognition of cultural phenomena and an appreciation of the role of culture in human behavior. But we find virtually no conception of a science of culture among them, no appreciation of the fact that cultural phenomena constitute a separate and distinct order; that cultural elements act and react upon each other according to laws of their own; that culture *as such* can be explained only in terms of culture; that culture not only *can* be studied apart from the psycho-

[61] "Culture and Human Society," p. 6 (Social Forces **23**: 6–15. Oct. 1944).

[62] *Ibid.*, pp. 14, 13.

[63] "The Validity of the Culture Concept," p. 208 (Amer. Journ. Sociol. **35**: 1929).

[64] "The Cultural Approach to Sociology," p. 191 (Amer. Journ. Sociol. **29**: 188–199. Sept. 1923).

[65] "The Trend to Internationalism," p. 181, and "Sociology," p. 243, both in Encyclopedia of the Social Sciences.

[66] *Knowledge for what?*, pp. 22, 27.

[67] *Introduction to sociology*, p. 800 (New York, 1942).

logical reactions of human organisms, apart from "social interaction," but that it *must* be so studied; in fine, that a special science is required to study and interpret this special class of phenomena, and that this science is not a science of psychology, individual or social, or a science of society or "social interaction," but a suprapsychological science of culture: culturology.

With the creation of Sociology the boundaries of science were extended to embrace superindividual determinants of behavior. But, being but a science of group behavior, of collective psychological determinants, Sociology was unable to grasp and interpret superpsychological determinants. Science was, therefore, obliged once again to advance its frontiers by creating a new science. This time it was Culturology.

It was the anthropologists who, as Prof. A. L. Kroeber[68] has observed, "discovered culture," and it has been within the province of anthropology that the science of culture has had most of its growth. The eminent British anthropologist Edward Burnett Tylor was the first person, so far as we know, to formulate in an explicit and self-conscious manner the point of view, the purpose, principles, and scope, of a science of culture. He was the first, too, so far as we know, to use the phrase "science of culture": it was the title of chapter 1 of his *Primitive culture* (1871). We do not mean to assert that Tylor was the first to take a culturological point of view or to produce a culturological work; there were, of course, others before Tylor who did this to a greater or lesser extent. But so far as we are aware, Tylor was the first to define and describe the new science.

To begin with, Tylor gave us what has probably been the most satisfactory definition of culture that we have ever had until recently. "Culture," he says in the opening words of *Primitive culture*, "is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society." Secondly, Tylor makes it clear that this new science will take as its object of study, *not* human behavior, nor social process or interaction, but culture traits themselves as a separate and distinct class of phenomena. The study "not of tribes and nations, but the condition of knowledge, religion, art, custom, and the like among them"[69] is the task he sets for his science. He proposes first to classify culture traits into categories such as weapons, myths, rites, social customs, etc., and then to "make out their distribution in geography and history and the relations which exist among them."[70] It is the *relations between culture traits*, relations historic, geographic, and functional, that Tylor is concerned with, not relations between human beings (i.e., "social interaction").

The next noteworthy attempt to establish a science of culture was that of Émile Durkheim.[71] In a great deal of his work, but especially in *The rules of sociological method* —above all in the preface to the second edition of this work—Durkheim endeavored to formulate the premises and principles of culturology. His phraseology was unfortunate, however, since it rather effectively concealed his true thought.[72] In the first place he calls his science "sociology" rather than a "science of culture" as Tylor did, and he lacks the terminology to distinguish between the social and the cultural. He designates the class of traditional superpsychologic symbolic phenomena which we call "culture" by such terms as "collective consciousness," which has not only obscured his thought but has brought upon him the charge of mysticism. But to one who can reach his thought and meaning through the façade of inappropriate terminology, it will be quite apparent that

[68] "So-Called Social Science," pp. 331, 333 (Journ. Social Philos. 1: 317–340. July 1936).

[69] *Primitive culture*, vol. 1, p. 5.

[70] *Ibid.*, p. 8.

[71] Having previously stated that the founding of the science of culture was primarily the work of anthropology the question arises, Was not Durkheim a sociologist? It is, of course, a fact that Durkheim called his science "sociology." But it is also true that its nature and content were very different from the works of most sociologists. As Bernard has put it, "the Durkheim school generally has been closer to anthropology than to sociology" (article "Social Psychology," p. 154, in Encyclopedia of the Social Sciences).

[72] See the opening words of Durkheim's preface to the second edition of *The rules* for his own statement about how he was misunderstood by his colleagues.

Durkheim is talking about *culture* rather than "society" or "social interaction," and that he is trying to establish a science of culture.

Durkheim is speaking of culture when he says:

> . . . collective ways of acting or thinking have a reality outside the individuals who, at every moment of time, conform to it. These ways of thinking and acting exist in their own right.[73] Collective representations are the result of an immense co-operation, which stretches out not only into space but into time as well; to make them, a multitude of minds have associated, united and combined their ideas and sentiments; for them, long generations have accumulated their experience and knowledge."[74]

Durkheim leaves no doubt that he is concerned with what anthropologists such as Tylor, Kroeber, and Lowie have called *culture* even though he uses the term "society." "It is not true," he says,[75] "that society is composed of individuals only; it also includes *material objects* which play an essential role in the common life" (emphasis ours). Among these material objects he lists "houses, buildings of all kinds which, once constructed, become autonomous realities, independent of individuals . . . lines of communication and transportation, . . . instruments and machines used in industry. . . ."

That Durkheim is interested in the behavior of culture traits rather than the behavior of human organisms ("social interaction") is made clear by the following:

> We need to investigate, by comparison of mythical themes, popular legends, traditions, and language, the manner in which social representations [i.e., culture traits] adhere to and repel one another, how they fuse or separate from one another.[76]

Since culture is to be studied with reference to the ways in which traits act and react upon one another—"adhere to and repel one another"—it follows that culture is to be explained in terms of culture:

> Society [i.e., culture] is a reality *sui generis;* it has its own peculiar characteristics. . . . The determining cause of a social fact [culture trait] should be sought among the social facts [culture traits] preceding it. . . . We must seek the explanation of social life [culture] in the nature of society [culture] itself.[77]

A few sociologists have been able to see that Durkheim is talking about culture traits and their behavior rather than human organisms and their interactions, but most of his successors have either tried to reduce his culturology to the social psychology of interaction or have dismissed it as "mysticism." Despite misunderstanding, however, Durkheim's influence has been considerable, and he will eventually come to be recognized as one of the founders of the science of culture.

In the works of Tylor and Durkheim the science of culture got off to a good start in the nineteenth century. But progress in this field has been rather meager in recent decades. A considerable amount of work of a culturological nature has been produced by American and European anthropologists. But little advance in the development of the theory of such a science has been made. There has, in fact, been considerable opposition to the culturological point of view, and numerous signs point to regression from the level attained by Tylor and Durkheim.

Prof. A. L. Kroeber has undertaken to formulate the philosophy of a science of culture on several occasions, notably in the following essays: "The Superorganic,"[78] "The Possibility of a Social Psychology,"[79] "On the Principle of Order in Civilization as Exemplified by Changes in Fashion,"[80] "Sub-Human Cultural Beginnings,"[81] "So-Called Social Science,"[82] and, finally in his recent huge work, *Configurations of culture growth*.[83] Like Comte, Kroeber is concerned with the "hierarchy of the sciences." He distinguishes cultural phenomena from

[73] *The rules of sociological method*, p. lvi (Chicago, 1938).
[74] *The elementary forms of the religious life*, p. 16 (London, 1912).
[75] Translated from *Le suicide*, p. 354 (Paris, 1897).
[76] *Rules*, p. li.
[77] *The elementary forms*, p. 16; *Rules*, pp. 110, 102.
[78] Amer. Anthrop. **19**: 163–213. 1917.
[79] Amer. Journ. Sociol. **23**: 633–650. 1918.
[80] Amer. Anthrop. **21**: 235–263. 1919.
[81] Quart. Rev. Biol. **3**: 325–342. 1928.
[82] Journ. Social Philos. **1**: 317–340. 1936.
[83] Berkeley, Calif., 1944. See my review of this work in Amer. Anthrop. **48**: 78–93. 1946.

psychological phenomena. "Civilization," he says, "is not mental action but a body or stream of mental exercise."[84] He distinguishes the psychological from the cultural in the instance of Darwin's formulation of the theory of natural selection: the "reactions in Darwin's nervous system at the moment when the thought of natural selection flashed upon him," are contrasted with "the relation of doctrines such as that of natural selection to other concepts and social [cultural] phenomena."[85] In short, Kroeber envisages a science that would concern itself, not with psychological events, but with the actions and reactions of superorganic (cultural) phenomena. In speaking of the reaction of one concept on another, Kroeber is thinking as Durkheim was when he spoke of the way in which "social representations [culture traits] adhere to and repel one another, how they fuse or separate from one another."

Culture, as a class of suprapsychic—or superorganic, to use Kroeber's term—phenomena constitutes a distinct order of reality, in Kroeber's conception. "The superorganic or superpsychic . . . that we call civilization [culture] appears to have an existence, an order, and a causality as objective and as determinable as those of the sub-psychic or inorganic," he says.[86] He also thinks of culture as a "closed system of phenomena," which means that "the first explanation of cultural phenomena must be in cultural terms."[87]

Professor Kroeber is not able to hold consistently to the culturological point of view, however. He appears to think that culturological explanations can be only historical;[88] generalizations dealing with nontemporal aspects of cultural phenomena would, he reasons, belong to psychology, as is indicated by the title of one of his essays, "The Possibility of a Social Psychology." He is not quite able to conceive of scientific laws of culture itself. Instead, he speaks of laws which *underlie* culture, and these are "the laws of psychology."[89]

Kroeber has pointed out "the fatal defect" of the term "sociology": its failure to distinguish the cultural from the social.[90] But he does little to remedy this shortcoming, since in the same essay where the defect of "sociology" is exposed, he suggests that the science of culture be called "cultural mechanics," "social psychology," and even "sociology."[91] If only he could have crystallized his thought in a new term: "culturology!"[92] In a later essay,[93] he does use the

[84] "The Superorganic," p. 192.

[85] *Ibid.*, p. 206.

[86] *Idem*, p. 263.

[87] "Sub-Human Cultural Beginnings," p. 325.

[88] "Anthropology belongs in the group of the historical sciences," *Anthropology*, p. 325 (New York, 1923).

[89] *Loc. cit.*

[90] "The Possibility of a Social Psychology," p. 641.

[91] *Ibid.*, p. 640.

[92] I hasten to say that I am not the first to use this term in print. Read Bain, a sociologist, speaks of "culturology" in "Trends in American Sociological Theory" (in *Trends in American sociology*, G. A. Lundberg et al., editors, New York, 1929). Dr. Cheng Che-Yu published *Oriental and Occidental cultures contrasted: An introduction to "culturology,"* in 1943 (Berkeley, Calif.). He has written me that he has used "culturosophy" as well as "culturology" in earlier publications in China. I first used "culturology" in print in 1939, I believe ("A Problem in Kinship Terminology," Amer. Anthrop. **41**: 566–573), but I employed it regularly in lectures for some years prior to that date.

"Culturology" may, from its novelty, sound affected or pretentious today. But we recall that friends of Herbert Spencer condemned the word "sociology" as a "barbarism" (Preface to vol. 1, *Principles of sociology*). "Culturology" also will become familiar with the maturity of "social" science and will eventually be accepted as a matter of course. If the scientific study and interpretation of mammals is "mammalogy," the science of minerals "mineralogy," of music, "musicology," why should not the science of culture be called "culturology"? The importance of new words for new conceptions is well expressed by Henri Poincaré: " . . . the true discoverer will not be the workman who has patiently built up some of these combinations, but the man who has brought out their relation. . . . *The invention of a new word will often be sufficient to bring out the relation, and the word will be creative*" (emphasis ours), "Science and Method," p. 28 (in *Foundations of science*, New York and Garrison, 1913).

If Durkheim could only have used "culture" and "culturology" instead of "society," "collective consciousness," "collective representations," and "sociology," he would have spared himself misunderstanding that has persisted even to the present time. His failure to do so is remarkable in view of his realization of the necessity of new concepts and new terms as science advances: "We need . . . to formulate entirely new concepts, appropriate to the requirements of science and expressed in an appropriate terminology" (p. 37, *The rules*).

[93] "So-Called Social Science," p. 238.

phrase "science of culture," however. And he displays a keen understanding of the direction that science is taking when he observes: "It does look as if the future science would be more concerned with culture than with society."[94]

Prof. Robert H. Lowie (an anthropologist) gives us a clear expression of the culturological point of view in his various writings. To him, culture constitutes a distinct class of suprapsychological phenomena which requires a special science for its interpretation. "During the last hundred years," he writes, "it has become increasingly clear that culture . . . represents . . . a distinct domain.[95] We have [in culture] a thing *sui generis* that demands for its investigation a distinct science."[96] This distinct science is to be a "science of culture," as he calls it in a recent essay.[97] The science of culture is to be distinguished sharply from a science of mental phenomena: "We cannot reduce cultural to psychological phenomena. . . .[98] Culture . . . can be explained only in terms of itself."[99] Like Durkheim and Kroeber, Lowie sees that culture traits *as such* act and react upon each other: "culture thus appears as a closed system."[1] It is therefore the business of the ethnologist [culturologist] to show how one cultural element is determined by, or influences, other culture traits. He shows, for example, how a type of kinship terminology is determined by rules of marriage and descent.

Clark Wissler, likewise an anthropologist, takes the culturological point of view in much of his work. He regards the "culture concept [as] one of the most recent and important achievements in anthropological research."[2] He distinguishes psychology, the scientific explanation of the way people behave, from anthropology, the study of the way culture traits, or cultures, behave. In fact, he advocates the study of "culture as independent of human beings."[3] Like Tylor, Wissler states that the task of the anthropologist is to "describe and classify these inventions [culture traits], to study their distribution over the earth, and above all the gross outlines of their history."[4] Wissler is interested in the evolution of culture, the history of specific traits and complexes, and in relationships obtaining between traits. "All cultures," he maintains, "follow out their careers according to discoverable laws,"[5] and it is the anthropologist's business to discover and to formulate these laws.

Wissler does not, however, fully appreciate the extent to which the culturological point of view can be applied. Instead of trying to explain such traits as the couvade and incest prohibitions in terms of the interaction of other culture traits, he turns them over to the psychologist.[6] He would thus restrict the science of culture to an unwarranted and unfortunate degree and deprive it of much opportunity for achievements. But this blind spot does not lessen the merit of his culturological work in other areas of interpretation.

Wissler's insight and understanding concerning the expansion of the scope of science and of the direction which this expansion is taking is shown in the following passage:[7]

> Thus, it was an easy step from the realization of the individual to the conception of society. . . . Such a consciousness of ourselves functioning as a group is coincident with the rise of sociology . . . and whereas a century or more ago men were thinking in terms of the individual, they came during the last half century to see themselves in society. It is then a curious fact that for a long time man was so intent upon his individualism, he failed to sense the existence of society, and that to such a thing as culture was totally blind. But we have seen how our people are just becoming conscious of the existence of culture. . . . So while we have attained social consciousness . . . into culture consciousness we are just now groping our way.

Prof. G. P. Murdock has a fine exposition of the culturological point of view in his

[94] *Ibid.*, p. 337.
[95] "Cultural Anthropology: A Science," p. 301 (Amer. Journ. Sociol. **42**(3). Nov. 1936).
[96] *Culture and ethnology*, p. 17.
[97] "Cultural Anthropology: A Science," p. 307.
[98] *Culture and ethnology*, p. 17.
[99] *Ibid.*, p. 66.
[1] *Idem*, p. 95.
[2] "Recent Developments in Anthropology," p. 75, in *Recent developments in the social sciences*, E. C. Hayes, editor (Philadelphia, 1927).
[3] *Man and culture*, p. 99 (New York, 1923).
[4] "Recent Developments in Anthropology," p. 87.
[5] *Man and culture*, p. 247; also p. 363.
[6] "Recent Developments in Anthropology," pp. 62–63, 73, 84.
[7] *Man and culture*, pp. 333–334.

essay "The Science of Culture."[8] Dr. Bernhard J. Stern, also, touches upon it in an illuminating manner in his article "Concerning the Distinction between the Social and the Cultural."[9] It would be interesting to note expressions of the culturological point of view in the works of other men if sufficient space were at our disposal. But we have cited enough to show that some progress in the direction of a science of culture has been made since the days of Tylor and Durkheim.

But the new science has encountered considerable opposition as well as support. The extension of the point of view of science to the realm of human institutions has aroused the opposition and resentment of champions of the older philosophy of free will. As Durkheim has expressed it:[10]

> The same antagonism breaks out each time a new science is founded . . . on more than one point, the natural sciences themselves found an obstacle in faith. But it is especially when man became an object of science that the resistance became fierce. The believer, indeed, cannot but find repugnant the idea that man is to be studied as a natural being, analogous to others, and moral facts as facts of nature. It is well known how these collective sentiments, under the different forms they have taken, have hindered the development of psychology and sociology [culturology].

Opposition to a science of culture is not confined to nonscientists, however. We have already noted the opposition of certain sociologists, and there is considerable opposition to culturology among anthropologists themselves.

Kroeber's early attempt, in "The Superorganic" (1917), to formulate the culturological point of view and to advocate a science of culture was met with speedy and spirited opposition. Edward Sapir, in a skillfully argued essay entitled "Do We Need a Superorganic?" tried to show that no such concept, and consequently no special science, was needed.[11] Alexander Goldenweiser, also in a reply to Kroeber's essay "The Super-Organic," likewise opposed a superpsychological science of culture.[12] "The life of culture," he argues elsewhere, "belongs to the psychological level. It is in the minds of men in society. . . . The historian, the anthropologist, are students of life. Life is psychology."[13]

It seems likely that Franz Boas had Kroeber in mind when he wrote, "It seems hardly necessary to consider culture a mystic entity that exists outside the society of its individual carriers and that moves by its own force."[14] Like Lynd, Boas would insist that "cultures do not enamel their finger nails but that people do." Ruth Benedict, too, can see nothing but mysticism in Kroeber's attempt to formulate a science of culture as a class of phenomena *sui generis*. She speaks of those who "have often expressed themselves in mystical phraseology . . . like Kroeber they have called in a force he calls the superorganic to account for the cultural process."[15] Being unable to understand or to appreciate a science of suprapsychological phenomena Boas and Benedict simply brand the idea "mystical" and reject it.

The reaction against the culturological point of view in American anthropology in recent years has gone so far as to receive the following summary expression in the words of David Bidney[16]: "The tendency to hypostasize culture and to conceive it as a transcendental, super-organic, or superpsychic force . . . the assumption that culture is a force that may make and develop itself" is one of the *major* "cultural fallacies" of our day. It is the "culturalistic fallacy," to be specific, he tells us. Dr. Bidney fails to appreciate the direction that science has been taking for more than a century, that it has been moving upward from the individual psychologic level to the social psychologic, and from there to the superpsychologic, or culturologic, level. He feels

[8] Amer. Anthrop. **34**: 200–215. 1932.
[9] Social Forces **8**: 264–271. 1929.
[10] *The division of labor in society*, pp. 285–286.
[11] Amer. Anthrop. **19**: 441–447. 1917.
[12] "The Autonomy of the Social," Amer. Anthrop. **19**: 447–449. 1917.
[13] "Anthropology and Psychology," pp. 85–86 (in *The social sciences and their interrelations*, WM. F. OGBURN and A. GOLDENWEISER, editors, New York, 1927).
[14] *Anthropology and modern life*, p. 235 (1928).
[15] *Patterns of culture*, p. 231 (1934).
[16] "On the Concept of Culture and Some Cultural Fallacies," Amer. Anthrop. **46**: 30–44. 1944.

only the impact of the *current* reaction against this trend and consequently does no more than serve as the passive medium of its expression.

Many anthropologists are still unable to rise above the level of a sociological, or sociopsychological, conception of human behavior. Thus Radcliffe-Brown ridicules the notion that two cultures can react upon each other, or that a culture can exert an influence, or produce an effect, upon an individual human being. Culture, to Radcliffe-Brown, is merely "an abstraction," and he finds it "fantastic to imagine . . . two abstractions coming into contact and by an act of generation producing a third abstraction."[17] The idea that a culture can "act upon an individual" is, to Radcliffe-Brown, "as absurd as to hold a quadratic equation capable of committing a murder."[18] In theoretical outlook Radcliffe-Brown is a sociologist; he is incapable of envisaging a science of culture.[19] He asks: "Is a science of culture possible? Boas says it is not. I agree. You cannot have a science of culture."[20] But, he says, a science of societies is possible, and this is the proper goal of the social anthropologist.

Radcliffe-Brown confuses the issue very effectively by calling culture an abstraction. Words are culture traits. Why call them abstractions any more than the bark of a dog or the quack of a duck? The fact that words have a symbolic significance as well as auditory and physical properties does not make them "abstractions," any more than the sexual significance of the mating call of frogs makes this an abstraction. Polygynous households are culture traits. But why call one husband and three wives an abstraction any more than one atomic nucleus and three electrons? Why should social or ceremonial *forms* be called abstractions any more than cellular or molecular forms? A wild horse is not an abstraction. Why call a domesticated horse (a culture trait) one? Culture traits are very real things:[21] objects, acts, forms, sentiments and ideas which can be and are experienced as real things. There is no more reason for calling them abstractions than anything else in our experience.

As for culture's ability to "act upon an individual," it is remarkable to find a man who is so often identified with Durkheim arguing this question in the negative. It was one of Durkheim's chief theses that culture traits have an existence prior to and independent of the individual human organism, and that these traits impinge upon man from the outside and profoundly affect his behavior. And it is, of course, obvious that this is the case. From birth—and even before—culture traits in the form of ideas, sentiments, acts, and material objects act upon the human organism and cause it to behave in this way and that. And it is not so "absurd" as Radcliffe-Brown would have us think to "hold a quadratic equation [i.e., an idea or set of ideas] capable of committing a murder." A culture trait in the form of an idea may so stimulate the human organism as to cause it to kill another human being. This is in fact a very common thing in cases of witchcraft, the killing of one or both of twins at birth, and many other cultural situations. A culture trait in the form of a sentiment-charged idea will cause a Japanese general to disembowel himself in atonement for disgrace or failure, or an Occidental officer to blow out his brains with a pistol. It would of course be silly to argue that it was the person, the human organism, that actually does the killing in the examples just cited. Of course it was the human being. But—and this is the point at issue in a scientific analysis of behavior—it was the culture

[17] "On Social Structure," pp. 10–11 (Journ. Roy. Anthrop. Inst. Great Britain and Ireland **70** (pt. 1). 1940).

[18] "The Nature of a Theoretical Natural Science of Society," p. 21 (mimeographed notes, recorded stenographically, from a seminar at the University of Chicago, 1937).

[19] It is an interesting and noteworthy fact, however, that although Radcliffe-Brown has not been able to appreciate the *concept* of a science of culture and hence has repudiated and rejected such a concept, he has employed it effectively in some of his work. His "Social Organization of Australian Tribes" (Oceania **1** (1–4). 1930–31) is a good example of a culturological interpretation of superpsychological phenomena.

[20] "The Nature of a Theoretical Natural Science of Society," p. 71.

[21] Recall Durkheim's emphasis upon the proposition that social facts are *things* (*choses*). This proposition was "at the very basis of . . . [his] method" (*The rules*, p. xliii).

trait, not the human being, that was the *determinant of the behavior*, and hence was the *cause*, scientifically speaking, of the homicides. The human organism does not kill witches or commit hara-kiri because of any inherent property or tendency. As a matter of fact, self-destruction runs counter to powerful and deep-seated organic tendencies. But, under the powerful stimulation of cultural traits, acting upon the organism from the outside, the human being can be brought to homicide or hara-kiri. These acts are the organic responses to cultural stimuli, and in scientific phraseology, it is quite proper to say that the culture traits are the *causes*, the killings the results. If different cultural stimuli are applied, different results will be forthcoming. Thus, we see that far from being absurd to think of a "quadratic equation, i.e., a culture trait in the form of an idea-sentiment, committing a murder," or a suicide, it is realistic and scientifically valid to think in precisely this way.[22]

Prof. A. Irving Hallowell, too, emphasizes a point of view which would rule out a suprapsychologic science of culture. After quoting with approval Bidney's characterization of the culturological point of view as a fallacy, he says:[23]

> Although anthropologists often speak of the "movements" of culture or the "meeting" of cultural traits or complexes, this manner of speaking must be understood as an economical mode of abstract speech. In a literal sense cultures never have met nor will ever meet. What is meant is that *peoples* meet and that, as a result of the processes of *social interaction*, acculturation—modifications in the mode of life of one or both peoples—may take place. *Individuals* are the dynamic centers of this process of interaction . . . it is hard to see how culture—an abstract summation of the mode of life of a people—can exert an influence except as it is a definable constituent of the activities of *human individuals* in interaction with each other. In the last analysis it is *individuals* who respond to and influence one another (emphases ours).

We see here only the social psychologist, with, however, a marked individualistic bias. Hallowell thinks of culture only as the reactions of biological organisms. The interaction of culture traits as such seems utterly unrealistic to him. Hence he resolutely turns his back upon a science of culture.

Of course culture traits could do nothing were it not for human beings; they could not even exist. And who, we might ask, has ever thought otherwise? Certainly not Tylor, Durkheim, Kroeber, Lowie, Wissler, or any other culturologist that we know of. But it is a false realism to argue that culture traits do not react upon each other immediately and directly. A hoe is a culture trait. It acts directly upon and influences other culture traits such as division of labor between the sexes, customs of residence, food habits, religious beliefs and ceremonies, and so on. The introduction of the automobile in modern American culture directly affected many other culture traits: harness and carriage manufacture, the steel and rubber industries, road-building, urban development, roadhouses and tourist camps, consolidated schools, etc. To be sure, these cultural events could not have taken place had it not been for human organisms. But is our account of the influence of the automobile upon other culture traits made any more realistic by introducing these organisms into it? Not one whit. The development of the symphony or non-Euclidean geometry could not have taken place without the respiratory and digestive processes of composers and mathematicians. But to inject these physiologic processes into a scientific explanation of these cultural processes would not add a single thing to our understanding of them. On the contrary, it would only confuse because of their irrelevance. Thus we see that, although cul-

[22] We do not assert that the culturological point of view is nowhere implicit in Radcliffe-Brown's work. It is. As we have already noted, it permeates his fine study, "The Social Organization of Australian Tribes." When he distinguishes "social anthropology" from psychology in "The Methods of Ethnology and Social Anthropology," p. 133 (South African Journ. Sci. **20**: 124–147. Oct. 1923), he gives expression to the culturological point of view. What we have claimed here is that Radcliffe-Brown has explicitly and specifically opposed the theory of a science of culture. This is demonstrated by his own utterances. The fact that he not infrequently *does* culturology in no way invalidates this charge. Even scientists sometimes fail to square their behavior with their articulate theory.

[23] "Sociopsychological Aspects of Acculturation," pp. 175, 174 (in *The science of man in the world crisis*, RALPH LINTON, editor, New York, 1945).

ture traits have no existence, and hence can do nothing, without the agency of human beings, we can treat them scientifically as if they had an independent existence. In fact, as we have shown, the problem of the direct and immediate influence of one trait upon another can be solved most effectively by eliminating the human organism from our consideration entirely. Far from being unrealistic—or fantastic or absurd, in the words of Radcliffe-Brown—it is a common procedure in science. The physicist may treat falling bodies *as if* they fell in a perfect vacuum; or imagine an airplane passing without friction through the atmosphere. But no physicist is so naive as to protest that such things simply don't occur; it goes without saying that they do not. Every physicist knows that the most effective—if not the only—way to arrive at the formulas and propositions necessary to explain physical phenomena is to substitute *ideal* situations for *real* ones.[24] The only way, for example, to arrive at a law of falling bodies is to imagine them falling through a perfect vacuum—a situation that does not and can not exist on this earth.

Similarly the culturologist knows full well that culture traits do not go walking about like disembodied souls interacting with each other. But he realizes that he can explain cultural phenomena *as cultural phenomena* only when he treats them *as if* they had a life of their own, quite apart from the glands, nerves, muscles, etc., of human organisms. The remarkable thing about this argument is not that it is revolutionary, but that it should be necessary to defend it. It is neither revolutionary nor novel. As a matter of fact, scholars in many fields have been making culturological studies for decades. We have had studies of Indo-European and other languages on a purely linguistic, i.e., nonbiological, level. We have had studies of the evolution of currency; the effect of telescopes upon theological beliefs; the influence of the industrial revolution upon political institutions; the development of Greek tragedy, non-Euclidean geometry, Gothic architecture, and parliamentary government; the relationship between taxi dance halls and prostitution, delicatessens and the divorce rate; money spent on medical schools and death rates for contagious diseases, etc., etc. All these are culturological problems and their solutions are culturological. Need one insist that none of these situations could exist were it not for human organisms? It is obvious, of course, that they could not. But it is equally obvious that the introduction of human organisms into a consideration of these problems is not only not necessary, it is irrelevant and confusing. It is only the traditional habit of thinking anthropomorphically which still clings to "social science" that keeps one from seeing that in the man-culture *system*, it is the cultural, rather than the organic, factor that is the *determinant* of events within this system.

We see then that the culturological point of view, procedure, and objective are not new. Actually, scholars in philology, musicology, philosophy, mathematics, political science, economics, literature, and art have been making culturological studies for years. Our argument in support of a science of culture is necessary now only because the theoretical position taken today by many psychologists, sociologists, and anthropologists opposes this new science so vigorously.

The reaction against the culturological point of view has gone even farther than has been indicated above. Proceeding from the view that culture is "an abstraction," some anthropologists have argued that it is intangible and imperceptible and end up by questioning the very existence and reality of culture itself. Thus Linton observes:

> Any investigator of culture is at once confronted with the problem of its reality. Do cultures actually exist . . . ? Culture . . . is intangible and cannot be directly apprehended even by individuals who participate in it. . . .[25] If it [culture] can be said to exist at all. . . ."[26]

[24] Physics, says the distinguished physicist, Max Planck, "substitutes a new world in place of that given to us by the senses. . . . The other world is the so-called physical world image; it is merely an intellectual structure. To a certain extent it is arbitrary. It is a kind of model or idealization created in order to avoid the inaccuracy inherent in every measurement and to facilitate exact definition," *The philosophy of physics*, p. 53 (New York, 1936).

[25] *The study of man*, pp. 288–289.

[26] *Ibid.*, p. 363.

Herskovits regards culture as "intangible," but grants to culture patterns "the reality of any abstraction," whatever this may mean.[27] Thus culture is made virtually to disappear. And obviously if culture does not exist there can be no science of culture.

Vigorous opposition to a science of culture comes from Earnest Albert Hooton. Whereas anthropologists like Boas, Goldenweiser, Sapir, and others have essentially a psychological point of view, Professor Hooton's outlook is on a still lower level: the biological. To him the study of culture is but a branch of biology.[28] "Since man's behavior," he argues, "is a function of his organism . . . it is within the province of the physical anthropologist to survey also the cultural and psychological symptoms of the well-being or ill-being of the human animal."[29] Just as Lynd deplores the "artificial" separation of culture from people, so does Hooton bewail the attempt to disjoint culture from the blood, bone, and muscle of the human organism. "My only quarrel with the ethnologist and with the social anthropologist," he says, "is that they willfully abstract social phenomena and divorce man's activities as a social animal from man himself. [He deplores] the old way of considering social institutions completely apart from the human animals which produce them, as if the former lived, died, propagated and evolved independently, like parasites upon their human hosts."[30] Professor Hooton can see what culturologists are trying to do, but being unable to appreciate anything beyond the horizon of biology, he regards their objective as a great mistake. "We have been misled," he bemoans, "into the imbecilic assumption that culture, an inanimate thing consisting of humanly manipulated matter and disembodied ideas, evolves by itself ever onward and upward, and that all man has to do is to grease the wheels and ride."[31] Hooton has even gone so far, in his anti-culturological attitude, as to suggest that "it is possibly more profitable for the sociologist and the social anthropologist to study monkeys [who are, of course, cultureless, L.A.W.] than savages."[32]

Prof. C. W. M. Hart, too, deplores the separation of the cultural (or the social, for that matter) from the biological.[33]

Thus we see that although some progress has been made in the direction of realizing a science of culture in recent decades, there is also considerable opposition to it. Some, like Boas, are simply not able to grasp the concept of a special science devoted to a distinct and independent class of super-psychological determinants of behavior. Others, like Lynd and Hooton, see what culturologists are trying to do, but are convinced that they are on the wrong—a dangerously wrong—track.

As a matter of fact, anthropology has actually regressed in recent years from the levels attained by Tylor and Durkheim in the nineteenth century. We have, of course, an objective criterion and measure of advance and regression in the expansion of the scope of science. We may view the stages of this expansion as a series of strata, one laid upon another, the older strata on the bottom, the newer on top. Thus at one time we see the science of the behavior of man on the anatomical and physiological level. Subsequently science has advanced to the individual psychological level, then to the sociopsychological, and finally to the culturological, level. Thus by referring the point of view and objectives of anthropology at any given time to this developmental series, we can gauge its condition of advancement or regression.

Measured by this yardstick, anthropology has regressed considerably, especially since 1930.[34] Science attained the culturo-

[27] "The Processes of Cultural Change," pp. 150, 158 (in *The science of man in the world crisis*, RALPH LINTON, editor, New York, 1945.)

[28] Prof. Carleton S. Coon, a student and colleague of Hooton, thinks of sociology as a "subdivision of biology," *The races of Europe*, p. 251 (New York, 1939).

[29] *Apes, men and morons*, p. 272 (New York, 1937).

[30] *Ibid.*, p. 223.

[31] *Crime and the man*, p. 370 (Cambridge, 1939).

[32] HOOTON, E. A., "Why we study apes and monkeys," p. 5 (Fauna 5(1). 1943).

[33] "Social Evolution and Modern Anthropology," in *Essays in political economy*, in honor of E. J. Urwick; H. A. INNIS, editor (Toronto, 1938).

[34] Cf. "Recent Trends in American Ethnology," by BETTY J. MEGGERS, especially pp. 195–197 (Amer. Anthrop. **48**: 176–214. 1946).

logical level in anthropology. This is anthropology's distinctive achievement and mission: to formulate and develop a science of culture. Tylor and Durkheim formulated such a science. Kroeber, Lowie, Wissler, and others have carried it forward. But many students bearing the professional label of "anthropologist" have been unable to ascend to the culturological level and to grasp the concept of a suprapsychological science of cultural phenomena. Being unable to do this, they have opposed the culturological point of view. We have already seen how Boas, Sapir, Goldenweiser, and Benedict opposed it. Culture, Goldenweiser argues, "belongs to the psychological level. It is in the minds of men." Sapir, apart from linguistics, was primarily a psychologist. We get some notion of how far the anthropology of today is from the culturological position of former years from the following statement by one of our younger anthropologists, Dr. John Gillin:

> One of the greatest recent advances [in anthropological theory] is the realization by anthropologists that culture is a psychological phenomenon.

It is rather ironical that the article in which this observation appears should have been entitled "Some Unfinished Business of Cultural Anthropology."[35] The "unfinished business" is, of course, the development of a science of culture. The realization that culture is a "psychological phenomenon" is not an advance but a regression to a lower level in the development of science.

More recently Prof. M. J. Herskovits tells us that "the ultimate reality of culture is psychological."[36]

Not only has anthropology regressed to the psychological level; it has tended to go even below the *collective* psychological level and come to rest upon the level of *individual* psychology. "An analysis of culture," Goldenweiser argues, "if fully carried out, leads back to the individual mind."[37] To Boas the "working of culture" meant "the life of the individual as controlled by culture and the effect of the individual upon culture.[38] The causal conditions of cultural happenings lie always in the interaction between individual and society."[39] "It is always the individual that really thinks and acts and dreams and revolts," Sapir maintained.[40] Sapir's "approach to the problem was always through the individual," according to Ruth Benedict.[41] Hallowell asserts that "in the last analysis it is individuals who respond to and influence one another."[42] Linton takes the position than "culture . . . exists only in the minds of the individuals who compose a society. It derives all its qualities from their personalities and the interaction of these personalities."[43]

In line with this emphasis upon the individual, we note that the most popular trend in American anthropology today is the study of personality. "Depth psychology," inkblot tests, psychiatry, etc., are now almost *de rigueur* these days for the up-to-date anthropologist. Thus we see that much of anthropology today has regressed to a level even below that of most sociologists and some social psychologists. And in some of Hooton's work, anthropological theory has regressed even lower and has reached the biological level. His interpretation of social disorders in terms of inferior germ plasm and his advocacy of social reform through biological purges, are expressions of this point of view.[44]

In a recent work Kroeber has once again given expression to the culturological point of view:[45] "I am convinced that, the phenomenon being cultural, the explanation must

[35] In Ohio Arch. and Hist. Quart. **48**: 45. 1939.

[36] "The Processes of Cultural Change," p. 163. Why one should locate the "ultimate reality" of culture in psychological processes is not clear. If one reduces culture to the psychological level why not reduce psychological events to the physiological level, and these to the anatomical and these in turn to the chemical and physical levels—if one is concerned with ultimates.

[37] "Psychology and Culture," p. 59.

[38] "History and Science in Anthropology, A Reply," p. 137 (Amer. Anthrop. **38**: 137–141. 1936).

[39] "Aims of Anthropological Research," p. 612 (Science **76**: 605–613. 1932).

[40] "Do We Need a Superorganic?" p. 442 (Amer. Anthrop. **19**: 441–447. 1917).

[41] "Edward Sapir," p. 467 (Amer. Anthrop. **41**: 465–468. 1939).

[42] "Sociopsychological Aspects of Acculturation," p. 174.

[43] *The study of man*, p. 464.

[44] See, particularly, the essays in *Apes, men and morons* (New York, 1937), pp. 16, 154, 269–270, 294–295.

[45] *Configurations of culture growth*, pp. vii, 763.

first of all be made in cultural terms . . . psychological explanations have not got anyone very far in reducing the phenomena of history to order, and I shall not fall back on them." But in these days of personality studies and inkblot tests, Kroeber stands almost alone. How is anthropology's regression from culturology to psychology and psychiatry to be explained?

Long ago Tylor remarked upon the repugnance with which otherwise enlightened persons will regard a science of culture. "To many educated minds," he wrote, "there seems something presumptuous and repulsive in the view that the history of mankind is part and parcel of the history of nature, that our thoughts, wills, and actions accord with laws as definite as those which govern the motion of waves, the combination of acids and bases, and the growth of plants and animals."[46]

Durkheim, too, noted that the old anthropocentric philosophy of free will, which still dominates our thinking about man and his behavior, generates vigorous opposition to a science of culture. He wrote:[47]

> Numerous survivals of the anthropocentric bias still remain and . . . here as elsewhere, they bar the way to science. It displeases man to renounce the unlimited power over the social order he has so long attributed to himself; and on the other hand, it seems to him that, if collective forces really exist, he is necessarily obliged to submit to them without being able to modify them. This makes him inclined to deny their existence. In vain have repeated experiences taught him that this omnipotence, the illusion of which he complacently entertains, has always been a cause of weakness in him; that his power over things really began only when he recognized that they have a nature of their own, and resigned himself to learning this nature from them. Rejected by all other sciences, this deplorable prejudice stubbornly maintains itself in sociology [culturology]. Nothing is more urgent than to liberate our science from it, and this is the principal purpose of our efforts.

And more recently A. L. Kroeber has observed that a science of culture will have to win its way against the older philosophy of human free will:[48]

> Our minds instinctively resist the first shock of the recognition of a thing [cultural determinism] so intimately woven into us and yet so far above and so utterly uncontrollable by our wills. We feel driven to deny its reality, to deny even the validity of dealing with it as an entity; just as men at large have long and bitterly resented admitting the existence of purely automatic forces and system in the realm that underlies and carries and makes possible the existence of our personalities: the realm of nature.

These quotations do not merely distinguish between "social" science and "natural" science. They also distinguish between the philosophy of determinism and the philosophy of free will that still permeates much of the thinking of today.[49] Social science had won its way to the philosophy of determinism in the anthropology of the 1880's and 1890's: "If law is anywhere it is everywhere," said Tylor.

We find that anthropology has regressed at this point, too. We have exponents of free will in anthropology today, and this philosophy seems to be growing in strength and adherents. Dr. Margaret Mead believes that "man should democratically take control of his own destiny and build himself a world that is fit to live in."[50] Dr. John R. Swanton closes his essay "Are Wars Inevitable?"[51] with the assurance that "all that is needed [to terminate warfare] is the will to do so." Ralph Linton espouses the philosophy of free will and the theory of social change through education in his lecture to teachers entitled "Potential Contributions of Cultural Anthropology to

[46] *Primitive culture*, vol. 1, p. 2.

[47] *The rules of sociological method*, p. lviii, Preface to ed. 2 (Chicago, 1938).

[48] "On the Principle of Order in Civilization as Exemplified by Changes of Fashion" (Amer. Anthrop. **21**: 263. 1919).

[49] On this point Alfred North Whitehead makes the following penetrating observations: "A scientific realism, based on mechanism, is conjoined with an unwavering belief in the world of men and of the higher animals as being composed of *self-determining organisms*. This *radical inconsistency* at the basis of modern thought accounts for much that is half-hearted and wavering in our civilization. It would be going too far to say that it distracts thought. It *enfeebles* it, by reason of the *inconsistency lurking in the background*," p. 94, *Science and the modern world*, emphasis ours (Cambridge, 1933).

Much of anthropological thought is enfeebled—not to say crippled—today by a belief in man as a "self-determining organism" as the following quotations will show.

[50] Introduction to *Is Germany incurable?* by R. M. BRICKNER, p. 13 (New York, 1943). Mead's book, *And keep your powder dry*, is permeated with the philosophy of Free Will.

[51] Smithsonian War Background Studies, No. 12. Smithsonian Institution, May 11, 1943.

Teacher Education."[52] "I believe," he says, "that there are none of our current problems which cannot be solved if people will put their minds to them and it is the educator's task to make them willing and able to do this (p. 9). . . . If the educator can establish a particular value system in his pupils he can control the future of his society, not in detail but in gross. By the feeling which he establishes toward war, or toward unlimited accumulation of wealth, or toward social justice he can deflect culture change in desirable or undesirable directions (p. 16) . . . A society that genuinely believes in social justice can get social justice and the educator can do more than anyone else to establish this belief (p. 17) . . ."

Professor Linton makes the control of culture change seem very simple. Teachers, guided of course by a little coaching from the cultural anthropologist, will direct the course of social change as they please, "in desirable or undesirable directions," simply by establishing the proper "value systems" in their pupils and insuring the proper "feeling" toward social problems so that when they grow up they will be "willing and able to put their minds to these problems" and by so doing solve them.[53] This view is faintly reminiscent of what the clergy have been telling us for centuries: "If we will but purpose in our hearts. . . . " Or, as politicians, columnists, and rhetoricians put it: "If the democracies (peace-loving nations, the churches, the women, etc., etc.) of the world would only take a firm stand against war. . . . " To which one might add: "If New England had a subtropical climate they could grow grapefruit," or "If frogs grew fur the world might be made safe for chinchillas."

But the crassest expression of the doctrine of Free Will that we have seen recently is to be found in an article in the *American Anthropologist:* "The Concept of Cultural Crisis." Here we are told by Dr. David Bidney that "man, under God, controls his own cultural destiny and is free to choose and realize the ends he would achieve."[54]

We have, however, merely exhibited the opposition to a science of culture and demonstrated the occurrence of regression; we have not *explained* it. To undertake such an explanation would require another article, but we might suggest here that the regression we are witnessing in social science in general and in cultural anthropology in particular is but one aspect of a reactionary tendency that pervades Western Civilization today. The nineteenth century was one of expansion and growth of our social system as well as our technology; it was an era of progress. With the end of the period of colonization of backward lands and peoples in Asia and Africa, and the disappearance of the frontier in America, our social system reached the limits of its capacity for growth. Mass unemployment, overproduction, and glutted markets, relieved only by periodic world wars, are the indexes of this condition. An obsolete social system is striving to maintain itself against technological imperatives for change. Although there have been some gains—the destruction of the feudal houses of Romanoff, Hapsburg, and Hohenzollern—the *status quo* has had, on the whole, the better of it in the struggle. The powers victorious in the war just ended are dedicated to the *status quo ante bellum,* to the preservation of the old system of capitalism, empire and imperialism. Our whole life is pervaded, therefore, by reactionary purposes and ideals and to a great extent dominated by them. The victors of World War II will probably effect a continuation of this political and philosophic atmosphere for some time to come.

It is therefore not surprising to discover reactionary and regressive tendencies in present-day anthropology. It is both anti-evolutionist and anticulturological. The

[52] Published in *Culture and personality,* a pamphlet issued by the American Council on Education (Washington, D. C., 1941).

[53] For a fine statement on the control of culture change by education, see the quotations from Wissler and Durkheim in White, Leslie A., "Education: America's Magic" (School and Society **61**: 353–354. 1945).

[54] Amer. Anthrop. **48**: 541. 1946. Although this article was published in "the official organ of the American Anthropological Association," Dr. Bidney is not an anthropologist. He is a student of philosophy who has recently undertaken the task of putting anthropology's philosophical house in order.

outlook for the immediate future is not bright. But all science is still young and culturology is the youngest member of the family. Nor has social evolution reached the end of its rope. Culture is but a million years old and we have some twenty million years ahead of us—unless, of course, the techniques of destruction develop to the point of extermination. The way of life that "we fought to maintain" will eventually be discarded and forgotten. And with the advance of cultural and social evolution will go advance in philosophy and science. A science of culture will come eventually. Meanwhile, those who know what course the evolution of culture has taken in the past will know how best to serve the cause of science in the future.[55]

SUMMARY

Man is an animal, and like all other living beings he strives to live: to adapt himself to his habitat, to exercise some control over his environment so that life can be made secure and his kind perpetuated. Man has the same means of adjustment and control that other animals have: neuro-sensory-muscular-glandular, etc. But in addition to these purely animal means, he has a technique that is peculiarly human: articulate speech. With language man constructs philosophies in which the whole cosmos is evaluated and interpreted. In terms of these philosophies, man effects his adjustment to and control over his environment. The function of philosophy is at bottom a biological one.

The first philosophies of mankind were animistic, supernaturalistic, and anthropomorphic. The external world was explained, not in terms of its own properties but in terms of human psychological forces, in terms of spiritual beings with minds like our own. This primitive type of philosophy although emotionally satisfying, was, of course, ineffective practically, as a means of understanding and controlling the external world.

Gradually, after hundreds of thousands of years, a new type of philosophy was developed. It interpreted the external world in terms of its own properties instead of terms of wish and will projected from the human mind. Free will and caprice gave way to determinism and natural law. But this transition in point of view was not effected throughout the whole range of philosophy at once. On the contrary it began in certain areas of experience and spread from there to others. It got a foothold first in the study of the heavens and spread from there to other physical phenomena. Then it invaded the realm of biological phenomena, conquering first the anatomical, next the physiological, and finally the psychological levels. From the psychology of the individual, the new interpretation was extended to the psychology of society. And always, as the new naturalistic philosophy of science advanced, it pushed out and displaced the old philosophy of free will.

The order in which the various realms of nature were invaded and subdued by the new philosophy was determined by the following law: *Scientific interpretation will appear first and grow fastest in those areas where the determinants of human behavior are the weakest and least significant.* Since the primitive philosophy rested upon a projection of the human psyche into the external world, upon a confusion of the self with the not-self, the new philosophy would begin first and flourish best where the identification of the self with the external world was weakest, namely, in relation to the heavenly bodies and other inanimate objects. Biological phenomena were next brought within the scope of the new interpretation, and eventually social behavior.

But sociology, the science of society, was not the end of the road of science as Comte and many others supposed. There was one more class of determinants of human behavior to be dealt with, the most intimate and powerful of all: culture. Just as psychologists found it difficult to envisage a collective psychology beyond an individualistic one, so have sociologists found it hard to envisage a science of culture beyond the horizon of "social interaction." But science

[55] "The knowledge of man's course of life, from the remote past to the present, will not only help us to forecast the future, but may guide us in our duty of leaving the world better than we found it."—E. B. TYLOR, the closing words of *Anthropology* (1881).

can not and will not stop in its onward march, in its movement of expansion, until it has fulfilled its potentialities to the utmost, and this means until it has embraced and subdued the whole realm of human experience.

The science of culture is the next item of business on the agenda of science. Many of our "best minds" still talk as if the fate of civilization lay in the hands of man, to be wrecked or saved as he chooses of his own free will. Many are still prattling about how "we" are going to construct the postwar world, nursing, in Durkheim's phrase, the illusion of omnipotence. There is, as Tylor, Durkheim, Kroeber, and a few others have pointed out, a powerful and sometimes bitter antagonism to the view that it is not "we" who control our culture but that our culture controls us. And our culture grows and changes according to its own laws. As we outgrow our primitive and infantile notion of mastery and set about to learn the nature of the culture in which we live, we will have a less flattering conception of ourselves, perhaps, but a greater capacity for rational and effective living.

And so today, we witness one of the most critical and dramatic episodes in the long and exciting history of science. Advancing over the charred bones of hapless astronomers, put to death in a frantic attempt to stem the tide of the new philosophy, science has gone on to new conquests. After a bitter battle over Darwinism, science has securely held the field of biology. Psychology has at last made it possible to regard "minds" as objects, and Sociology has illuminated the laws of social interaction. It now remains to discover the principles of a million years of culture growth and to formulate the laws of this development. When this has been done, science will have captured the last remaining stronghold of the old philosophy; it will have reached its final boundary.

BOTANY.—*Variations of accessory vascularization in four species of* Citrus *and their possible application as new taxonomic characters.*[1]

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The floral vascular anatomy of higher plants has long been under surveillance by botanists, and the differences in vascular pattern of flowers and fruits are often believed to contain keys to the phylogenetic relationships between plants, as well as to provide additional characters for more accurate determination of a particular plant's taxonomic position among closely related species. In general, such studies have been chiefly concerned with the patterns formed by the vascular tissue supplying the various floral parts after its divergence from the floral stele. The occurrence of accessory vascularization in the floral pedicels and receptacles has been frequently overlooked, although in some plant groups, such as the Ochinaceae and Dipterocarpaceae (*1*), it is common.

A homologous type of accessory vascularization has been described for young vegetative stems, in which there often exists a system of vascular strands in the cortex which have no connection with the main vascular system. Haberlandt (*2*) mentioned that an independent cortical system of leaf-traces is formed in stems of the Calycanthaceae and many Melistomaceae; Heinricher (*3*) described such independent cortical strands for many species of *Centaurea*, which he concluded were, in all probability, genuine cauline bundles, i.e., bundles growing acropetally with the stem, but having no direct connection with other bundles of the vascular system. The ontogeny of such bundles in certain Ronalian stems was studied by Worsdell (*4*), who found that they originated independently in the cortex, and later on became connected with the petiole strands of the leaves, by the latter differentiating across the cortex to the cauline bundles.

Tillson and Bamford (*5*) studied the

[1] Grateful acknowledgement is made to Dr. W. T. Swingle for his suggestions in the preparation of this paper. The work was conducted under the sponsorship of the Science Research Council of the University of Miami. Received March 12, 1947.

floral vascular anatomy of 94 species of the Aurantioideae, but like most recent American anatomists their study dealt entirely with the main vascular patterns; no mention was made of the histology of the vascular elements or of accessory vascular bundles. A study of the floral anatomy of the Eureka Lemon, *Citrus limon*, by Ford (*6*) mentioned but gave no detailed account of the accessory vascular bundles in the receptacles; and a similar type of bundle was described for Ceylon curry, *Murraya koenigii*, by Venning (*7*).

In the course of a recent survey of the anatomy of flowers of the orange subfamily, it was noted that many species had extensive accessory vascular systems. Considerable variation was found between species in the type of accessory vascularization present, but the type present in any one species was fairly consistant in nature, thus possibly affording a character of taxonomic significance. This paper is presented in order to describe the types of accessory vascularization in several species of *Citrus*, and to point out the significant differences in such bundles between the species.

Flower buds, flowers, and young fruits included in this study were secured from trees growing in the field. Those of Eureka Lemon, *Citrus limon*, were obtained from the University of California's Experiment Station at Riverside, Calif.; Lime, *Citrus aurantifolia*, Sour Orange, *Citrus aurantium*, and Sweet Orange, *Citrus sinensis*, were gathered from the private collection in Dr. David Fairchild's Kampong at Coconut Grove, Fla. The specimens were fixed in formalin-aceto-alcohol, dehydrated with a tertiary butyl alcohol series, and embedded in paraffin. Both cross and longitudinal serial sections were cut 10 microns in thickness, stained with a safranine fast-green staining combination, and are permanently filed in the University of Miami Tropical Botany Histological Research Collection of slides.

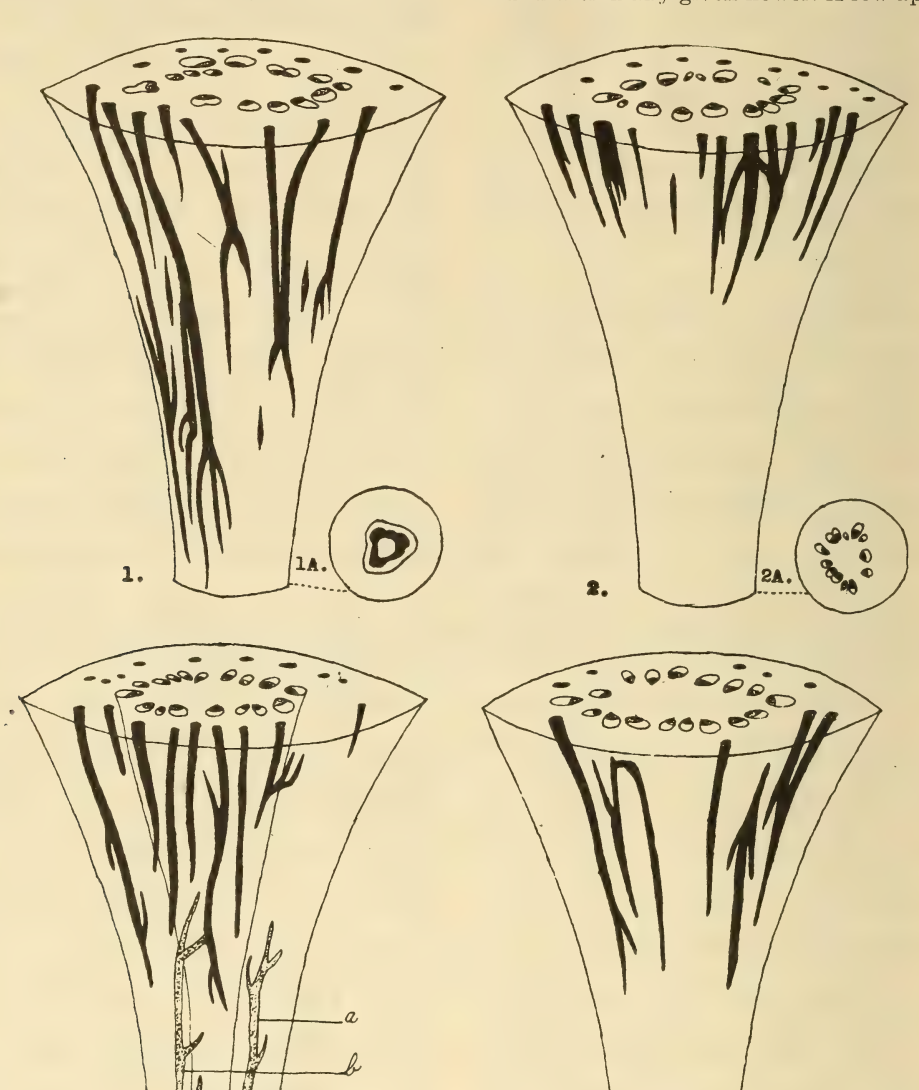
Citrus limon (Linn.) Burm.: Eureka Lemon

Floral pedicels in this species present a uniform pattern at the level where accessory vascularization appears. The main vascular bundles, around seven in number, are fused laterally into a cylindrical stele inclosing the large parenchyma cells of the pith (Fig. 1A). The arrangement of these bundles is always collateral, with well-differentiated xylem elements to the inside, and phloem parenchyma to the outside. The cortical parenchyma cells are large, isodiametric, and highly vacuolate, with large intercellular spaces. In the receptacle, the first bundles to diverge from the stele are the sepal midrib lateral petal bundles, which are fused when they leave the stele, but which separate near the sepal bases. Here the sepal midrib portion of the bundle branches several times; the branches enter the sepal base to either side of the midrib proper and form the lateral sepal bundles. The other two branches of the sepal midrib fuse with the lateral bundles of adjacent petals (Tillson and Bamford (*5*), Ford (*6*)). The lateral sepal bundles, in turn, are fused to branches of the petal midribs of adjacent petals. Considerable variation can and often does exist in this basic pattern of bundle arrangement in the calyx, as was noted by Ford (*6*); but essentially it is as described above. It should be noted that all these bundles in the pedicel, receptacle, and sepal bases retain a collateral orientation of their elements.

Accessory vascular bundles first appear in in the cortex of the floral pedicels about 3 mm below the base of the sepals, and below the level of divergence of the sepal midribs. Their lower termination is marked by several large xylem elements embedded in the cortical parenchyma, but only 10 or 20 microns above this point they usually consist of rather large masses of xylem, accompanied by numerous elongated thin-walled elements strongly resembling the protophloem and phloem parenchyma of the regular vascular system. These thin-walled elements do not show differentiation into sieve tubes and companion cells, and careful study reveals a nucleus in each of the cells. Many of them do show denser cytoplasm which has a greater affinity for fast green than the xylem parenchyma and surrounding cells of the cortex; a generally recognized characteristic of most phloem parenchyma.

The xylem elements which are first differentiated resemble in size and character those of the stele and consist of annular and spiral vessels, quickly followed by scalariform and reticulated tracheids. The provascular elements of these strands appear as early in the ontogeny

of the flower as those of the regular vascular supply, as was noted by Ford (*6*). They are originated from primary tissues deposited by the floral meristem. Unlike the bundles of the main vascular system, the orientation of the elements in the accessory bundles follows no set pattern. Many types of arrangement are found within any given flower. A few approach



FIGS. 1–4.—Diagrams of the pedicels and receptacles of the four species of *Citrus* discussed, showing the relative differences of accessory vascular bundle pattern between the species: 1, *Citrus limon*, accessory vascular bundles on one side of the pedicel indicated in black; 2, *Citrus aurantifolia*, showing the relatively short length of the accessory bundles; 3, *Citrus aurantium*, accessory bundles in black are free at their lower ends, stippled bundles are attached near or at their lower ends to sepal midrib xylem from the stele (*a*, attached accessory bundle which terminates in the cortical parenchyma; *b*, attached accessory bundle which connects near its upper end with a loose accessory bundle); 4, *Citrus sinensis*, showing relative differences between this and *Citrus aurantium*; 1A–4A, cross-section diagrams of the main vascular bundles in the pedicels of the four species. Note that *Citrus limon* (Fig. 1A) differs from all the others by forming a closed stele.

a collateral arrangement, others are bicollateral, concentric, or seemingly without any pattern of organization, the xylem and the thin-walled elements being intermingled at random (Figs. 5–10). The pericycle of the main bundles of most aurantioid flowers is at best poorly defined from the cortical parenchyma, and no lignification of pericycle occurs until the young fruit has begun development. No pericycle is distinguishable from other thin-walled elongated cells in the accessory bundles of flowers, but the pedicels of young fruits occasionally show pericyclic fibers in connection with the accessory vascular bundles.

As the flower bud approaches maturity, some of the large vacuolate cortical parenchyma cells lying next to the accessory xylem, and usually laterally to it, differentiate into tracheids with highly lignified reticulate thickenings, forming an irregular column extending most of the length of the bundle. The ontogeny of these cortical tracheids is vastly different from that of the original accessory bundle. Such tracheids are not restricted merely to the accessory bundles, but occur in conjunction with the main vascular bundles as well.[2]

Not all the accessory bundles have the same lower limits; rather, they appear at random as one progresses upward from section to section in the pedicel and receptacle. They may fuse or anastamose with one another, or branch to form several bundles, forming a complex pattern in the cortex. Often individual bundles are connected with one another by long chains of the cortical tracheids previously described, or they may be extended by such tracheids after the termination of the elements which diverge from the floral meristem.

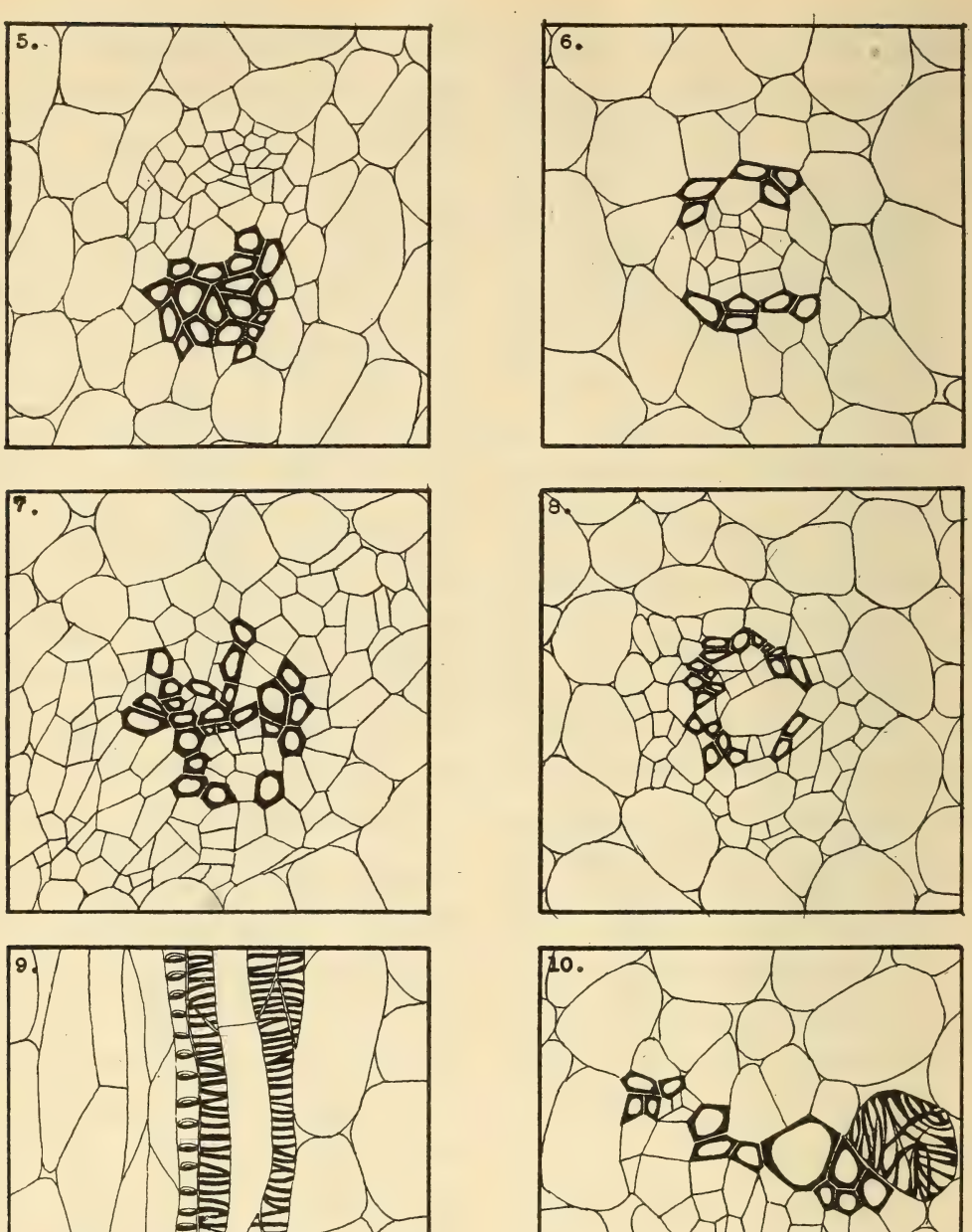
Ultimately, most of the accessory bundles in lemon become attached to branches of the sepal or lateral petal bundles, which curve down into the receptacle and connect with them. That they are not merely downward extensions of these bundles seems borne out by the fact that they are often much larger near the middle of their length, containing many more elements than at the point of connection with the sepal bundles; that the elements of the sepal bundles are arranged collaterally whereas in the majority of cases the accessory bundles are not; and, most important, there remain those accessory bundles which are always cauline, and which do not connect at either end with any of the main vascular system, nor with any other accessory bundle (Fig. 1). All the lemon flowers show the lower ends of the accessory bundles to be free, terminating in the cortex about halfway between the epidermis and the outer elements of the stele. No appreciable differences were noted in the arrangement of accessory vascularization between male and perfect flowers of the lemon, both kinds of flowers containing around 40 accessory bundles in all.[3] Maximum growth of the accessory bundles is attained by the time the flowers open; sections of the pedicels and receptacles of fruits show them no larger in size and with no further differentiation of elements, with the exception of occasional pericyclic fibers as previously mentioned.

Citrus aurantifolia (Christm.) Swing.: Key Lime

Histologically, the tissues in the pedicel and receptacle of the lime are of very similar character to those in the lemon. Arrangement of the main vascular system is also similar, and shows the fusion of the sepal midrib-lateral petal bundles, together with the fusion of the lateral sepal bundles with the petal midrib, as described for the lemon. The most striking difference between the main vascular systems of these two species is in the lower portion of the pedicels, for in the lime these bundles are not fused laterally into a stele, but are more or less separate (Fig. 2A). This is particularly true of the sepal midrib-lateral petal bundles, which

[2] As stated above, cortical tracheids are derived from highly vacuolate parenchyma of the cortex. The individual tracheids retain the approximate isodiametric shape of the original parenchyma cell, but develop lignified walls, after which the protoplasm disintegrates. They are of widespread occurrence under many circumstances in the Aurantioideae and have been described in detail in a separate paper by the present author (*8*).

[3] The method of determining the number of accessory bundles in a particular flower is necessarily somewhat arbitrary, because of the fusing, branching, and anastamosing between the accessory bundles. For this study, all free lower ends of the bundles were considered as individual bundles; if several of these were united above they were considered to be bundles which had fused together. If a bundle having a single lower strand split at a higher level into two or more bundles, these were considered as branches of a single bundle.



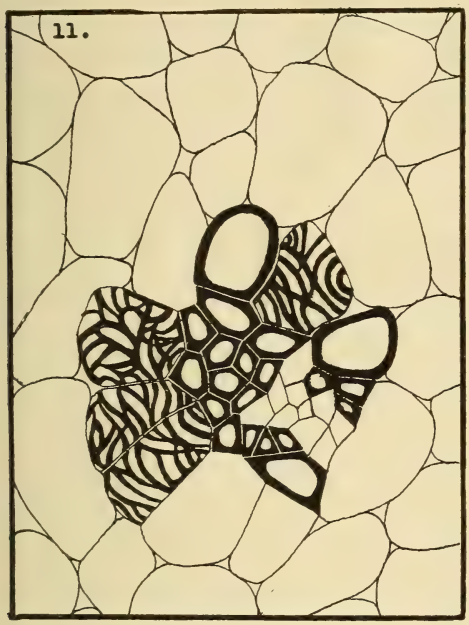
FIGS. 5–8.—Types of arrangement of the elements in the accessory bundles of *Citrus limon* (cross sections): 5, Accessory bundle with a collateral arrangement of elements; 6, bicollateral accessory bundle; 7, accessory bundle approaching a concentric orientation of vascular elements; 8, intermediate arrangement of accessory bundle elements.

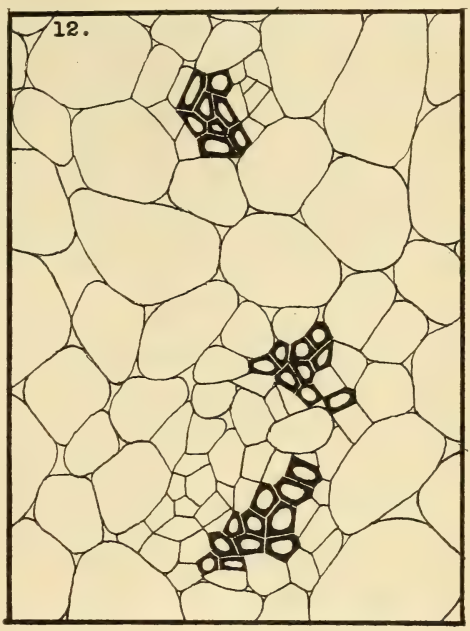
FIG. 9.—Longitudinal view of a portion of an accessory bundle in *Citrus limon*.

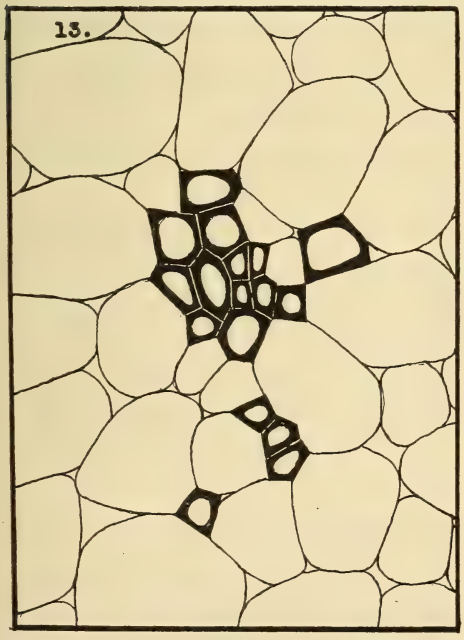
FIG. 10.—Accessory bundle from *Citrus limon* (cross section), accompanied by a column of large cortical tracheids derived from the cortical parenchyma. End view of tracheids shows the reticulate nature of the wall.

exist as distinct bundles from the base of the pedicel.

Accessory vascular bundles are slightly less than one-third as long, and appear much







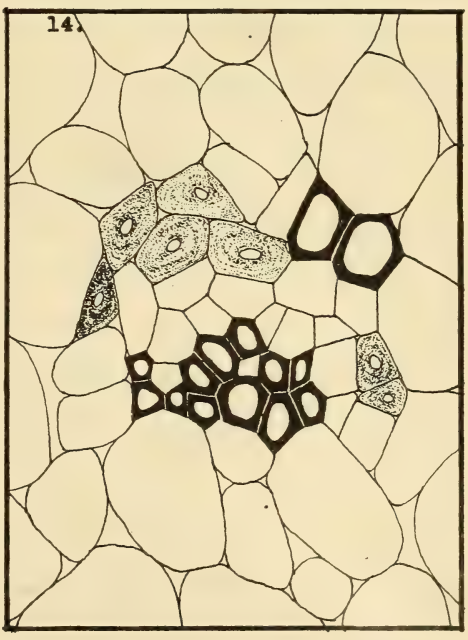


FIG. 11.—Loose accessory bundle in *Citrus aurantium* (cross section), showing extreme development of tracheids from the cortical parenchyma, forming a sheath around much of the original bundle.

FIG. 12.—Accessory vascular bundles in the cortex of *Citrus aurantifolia.*

FIG. 13.—Accessory bundle in *Citrus sinensis* which lacks elongated thin-walled elements; xylem is scattered between cortical parenchyma cells. (Cross section.)

FIG. 14.—*Citrus sinensis,* cross section of an accessory bundle from pedicel of a young fruit, showing pericyclic fibers. (Figs. 5–14, ×302 diameters.)

higher in the receptacle of lime than in lemon, usually not over 1 mm below the sepal bases. From this point upward they occur at random in the cortex, and most of them connect at the upper end with branches of either the sepal midrib-lateral petal bundles, or the petal midrib-lateral sepal bundles. Their lower ends, as with the lemon, are always free, and some few of the accessories also terminate in the sepal base without contacting any other portion of the vascular supply. The tissues composing these bundles are the same as described for lemon, and the same irregular arrangement of vascular elements was noted. The surrounding cortical parenchyma cells occasionally differentiate into cortical tracheids, but are not encountered with as great a frequency in this species (Fig. 12). There are only about three-fourths as many accessory bundles in flowers of the lime as in the lemon, usually around 30. They show considerable branching and anastamosing, but to a slightly lesser extent than in the lemon (Fig. 2).

Citrus aurantium (Linn.): Sour Orange

Like the lime, the bundles of the main vascular system do not form a closely fused stele in Sour Orange, but are more or less distinct, especially the sepal midrib-lateral petal bundles. The vascular bundles supplying the various floral parts have a similar pattern to those of lemon and lime, with fusion of the petal midrib-lateral sepal bundles. The nature and appearance of the tissues in the lower portions of the flowers is almost identical with that found in the lime.

There are two kinds of accessory bundles in this species. The first and longest bundles extend to 3 mm below the bases of the sepals. These lower bundles, usually 4 or 5 per flower, may have the lower termination free, but 40 or 50 microns above this point they are met with a small branch from a sepal midrib-lateral petal bundle; or the lower end of the accessory bundle may be directly attached to a sepal midrib-lateral petal bundle (Fig. 3). Such attached accessory bundles extend upward in the center portion of the cortex for approximately $1\frac{1}{2}$ mm, often put forth several short branches, and then either terminate in the cortex of the pedicel below the sepal base, or connect by a branch to one of the *loose* accessory bundles which appear higher up in the pedicel.

Loose accessory bundles, i.e., accessory bundles unattached below as were described for lemon and lime, first appear in the cortex about $1\frac{3}{4}$ mm below the sepal bases, or just before the ultimate termination of the attached accessory bundles. From this point upward they appear frequently, numbering about 35 in all. These bundles branch, fuse, and anastamose as do those of lemon and lime, but they always connect at the upper end with an extension of a sepal or petal bundle; none have been observed to terminate unattached in the cortex or sepal bases, although branches of these bundles do often so terminate.

The xylem and phloem parenchyma tissues closely resemble that of lemon and lime, and show the same heterogenous arrangement of the elements in relation to one another in both loose and attached accessory bundles.

There is an excessive number of cortical tracheids in conjunction with both loose and attached accessory bundles, in many cases almost forming a sheath around an accessory bundle (Fig. 11). It should be mentioned, however, that these peculiar tracheids are also of regular occurrence adjoining the sepal bundles of the regular vascular system in the sepals. No appreciable differences in accessory vascularization were noted between male and perfect flowers in this species.

Citrus sinensis (Linn.) Osbeck: Sweet Orange

The tissues of the pedicel and receptacle, together with the main bundle pattern, show no appreciable differences from Sour Orange, but the accessory bundles again show distinct differences (Fig. 4).

In Sweet Orange no accessory bundles were found with the lower ends attached to the sepal midrib-lateral petal bundle, as was described for Sour Orange. Instead, the accessory bundles first appear about $1\frac{3}{4}$ mm below the base of the sepals, as did the loose accessory bundles in Sour Orange. They number about 30, show much branching and anastamosing, and the great majority then terminate in the parenchyma of the sepal base without any connections with any portion of the main vascular system. A few in each flower finally connect at the upper end with a branch of a lateral sepal bundle, but these are the exception.

Histologically, these accessory bundles are

similar to those described for the preceding species. They differ in having fewer and sometimes no thin-walled elements (Fig. 13) and also fewer cortical tracheids than were found in Sour Orange. As in the other species, accessory bundles attain maximum size at the time of flowering, but develop some pericyclic fibers after the fruit begins to enlarge (Fig. 14).

DISCUSSION

No satisfactory explanation can at present be made to account for the presence or abundance of accessory vascular bundles in flowers of *Citrus*. An ingenious experiment on the bundles in living herbaceous stems by Caldwell (*9*), in which a dye was injected into the main vascular tissues, disclosed rapid and complete penetration of the dye throughout the entire main vascular system, but left all cauline bundles unstained. If cauline bundles in stems are homologous with the accessory bundles in flowers, this would tend to disprove their function as water-conductive tissue. The individual elements, however, do not in any way differ from those of the main vascular system. That they are "residual" bundles, remnants from a reduction in the number of floral parts, would not account for the irregular arrangement of the bundle elements. They may serve in a water-storing capacity; this explanation would possibly account for the large reticulate cortical tracheids adjoining them.

As can be seen in Figs. 1–4, the pattern of accessory vascularization between closely related species shows significant differences, although the pattern of the main vascular system does not. Thus they present a character which can be used taxonomically to distinguish between these species.

SUMMARY

Floral accessory vascular bundles are described for four species of *Citrus*. The histology of their elements, and their relation to the main vascular system is discussed. Differences in the kinds and arrangement of accessory bundles between the species are pointed out. It is suggested that these differences constitute characters that would be useful taxonomically in distinguishing between closely related species.

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PROCEEDINGS OF THE ACADEMY

409TH MEETING OF BOARD OF MANAGERS

The 409th meeting of the Board of Managers, held in the Cosmos Club, May 12, 1947, was called to order at 8 P.M. by the President, Dr. WALDO L. SCHMITT. Others present were: F. M. SETZLER, W. W. DOEHL, F. G. BRICKWEDDE, F. L. MOHLER, J. S. WADE, W. W. RUBEY, W. A. DAYTON, C. A. BETTS, M. A. MASON, O. B. FRENCH, C. L. GAZIN, and, by invitation, G. P. WALTON and A. T. MCPHERSON.

The Chairman of the Committee on Membership, Dr. DIEHL, presented four nominations, for resident membership in the ACADEMY and one for nonresident membership.

The Chairman of the Committee on Legisla-

tion, Dr. McPherson, presented an oral report on current legislation pertaining to science. He called attention to the Smith bill (S. 526) for the establishment of a National Science Foundation, pointing out some of its provisions and omissions, and to a bill (S. 1131) introduced by Senators Pepper and Murray that would authorize $80,000,000 for scholarships in the fiscal year 1948 and larger amounts in subsequent years, together with a revolving loan fund of $250,000,000. Dr. McPherson directed attention also to Bulletin 35 of the Office of Scientific Personnel of the National Research Council, which describes the far-reaching possibilities of Public Law 584 (Fulbright bill) enacted by the 79th Congress. This law authorizes proceeds from the sale of surplus property abroad to be used for financing studies, research, and other educational activities both for Americans abroad and for foreign nationals in the United States, the act to be administered by a Board of Foreign Scholarships to be appointed by the President. There was discussion of the types and scope of scientific work that might be done under Public 584, and it was decided that the Committee on Legislation should inquire into the means by which scientific interests might be given more prominence in the administration of the law. The President of the Academy suggested that copies of Bulletin 35 as well as of Public 584 be obtained for members of the Board of Managers. Dr. Brickwedde volunteered to procure them.

The Secretary reported receipt of a letter from K. E. Lohman, of the Geological Society of Washington, announcing the joint purchase, by seven Washington scientific societies including the Academy, of a Spencer Delineascope, Model GK, to be used by the societies for their meetings held in the assembly hall of the Cosmos Club.

The meeting was adjourned at 8:55 p.m.

C. L. Gazin, *Secretary.*

Obituaries

Albert Clayton Hunter, for 24 years a resident member of the Academy, died suddenly of a heart attack on April 13, 1946, at his home in Hillendale, Md. Dr. Hunter was born in East Providence, R. I., on February 23, 1893. He was educated in New England, earning his bachelor's degree at Rhode Island State College and his master's and doctor's degrees at Brown University.

While yet a graduate student he held a position as bacteriologist with the Narragansett Bay Oyster Co. This experience and the influence of his professors at Brown University, eminent in the field of sanitary science, doubtless served to interest him in the field of food science and control. At any rate, following the completion of his doctorate work in 1918 he entered the service of the United States Government as a bacteriologist in the Bureau of Chemistry, Department of Agriculture, and when later, in 1927, the Food and Drug Administration was established he became a leading figure in that agency of Government service.

At the time of his death Dr. Hunter was chief of the Food and Drug Administration's Division of Microbiology and was an authority on food and drug microbiology, food infection and intoxication, food industry sanitation, public health, and the legal and law enforcement aspects of these subjects. Among other affiliations he was a member of the Society of American Bacteriologists, a fellow of the American Public Health Association, a member of the Institute of Food Technologists, the Washington Academy of Sciences, and Sigma Xi.

Dr. Hunter's capacity for leadership, his ability to direct and lead associates, and his personal charm were conspicuous. He analyzed situations clearly and spoke well and to the point. His death was a distinct loss to science, for his achievements amounted to a real contribution to the microbiology and scientific control of food and drugs, and his career fully measured up to the calibre of a "distinguished Government scientist and administrator."

Dr. Hunter is survived by his wife, Mrs. Elizabeth H. Hunter, and by two brothers and a niece.

Leland W. Parr.

Gifford Pinchot.—As time rolls on it takes with it the great men who have done much to improve conditions in our world, added materially to our knowledge, or helped to brighten our lives. So it was with Gifford Pinchot, who passed away in New York City on October 4,

1946, after a long and distinguished and useful life. He was born on August 11, 1865, at Simsbury, Conn., where his people had an attractive home, and it was amid these New England surroundings that the lure of the forest must first have impressed itself on his youthful mind —an impression that later broadened and made him a tireless crusader for the creation of national forests. He was graduated from Yale University in 1889, later receiving honorary degrees from Yale, Princeton, Michigan Agricultural College, Pennsylvania Military College, and McGill and Temple Universities. In 1914 he married Cornelia Elizabeth Bryce. Dr. Gifford Bryce Pinchot, of New Haven, is their only child.

In January 1892, Pinchot started his American systematic forestry work at Biltmore, N. C., becoming the first professional American forester. To prepare for this work he had built up a substantial background by studying forestry problems in France, Germany, Switzerland, and Austria. After he completed his work at Biltmore in 1896, he became a member of the National Forest Commission, and two years later he was appointed forester and chief of the Forestry Division of the U. S. Department of Agriculture, which developed into a bureau and later into the Forest Service as we know it today. This office he held until 1910. It was very fortunate that during this period Theodore Roosevelt, a true American, who always was eager to improve conditions in his country, was President. Roosevelt was in full accord with Pinchot's forestry policies and was ever ready to proclaim national forests as soon as the projects were carefully worked out and completed. The result of this fine cooperation was that great areas of forest growth were preserved that otherwise would have been destroyed by wanton or selfish exploitation.

During the period between 1902 and 1910 Pinchot was very active in national projects relating to forestry, conservation, waterways, and country life. He was president of the National Conservation Association, 1910–1925, and professor of forestry at Yale, 1903–1936. He was a member of the following organizations: Society of American Foresters, American Forestry Association, Washington Academy of Sciences, American Ornithologists' Union (life associate), Washington Biologists' Field Club, Royal English Arboricultural Society, Boone and Crockett Club, Cosmos Club (president, 1908), Century Club, and Explorers Club. At one time the monthly meetings of the Society of American Foresters were usually held at Pinchot's Washington home. They were popular and well-attended occasions, and often at the close members enjoyed a repast of molasses cake and milk. He also was keenly interested in the Washington Biologists' Field Club, and when attending meetings and social occasions at its field headquarters at Plummer Island, Md., he was in high spirits.

In 1902 he inspected the forests of the Philippines and later recommended a forest policy for the islands.

During his political career Pinchot was twice elected governor of the Commonwealth of Pennsylvania, 1923–1927 and 1931–1935.

He was the author of many publications on forestry subjects, conservation, fishing, and kindred topics. Those interested should be thankful that he completed the manuscript of his history of the Forest Service before his death, for this posthumous work will contain a very complete story of the organization and development of that agency, which should prove of great interest to the public.

Pinchot was a gracious host, a devoted friend, and a charming companion. Although militant and aggressive in controversies, he was always fair and recognized that when both parties were sincere each had a right to its opinion. As an illustration of this trait: when he was organizing and stabilizing the Forest Service, and important details were being criticised that he considered essential, he would make special effort to visit the critic, and on two occasions at least he was elated when he succeeded in inducing his adversary to come to Washington and join him in forest work.

Not far from his attractive and substantial Milford, Pa., home he owned 1,500 acres of forestland, through which flowed a stream well stocked with trout. As an ardent and skilled angler, when time could be spared from duty, he keenly enjoyed fishing for this attractive and elusive species. Fishing was his pet avocation, and great must have been the number of species of fish that he brought to net or gaff during his many years of extensive travel.

During the 50 years that Pinchot and the writer were closely associated, he often spoke of the South Sea Islands with keen interest and eager expectations. In 1914 he was planning what might have been a honeymoon trip to the

South Seas if World War I and his subsequent duties in Belgium had not put a stop to it. But the old saying that "everything comes to him who waits" proved true for him, for in 1929 he was able to make the long- and well-planned expedition to the South Seas. The trip, on the yacht *Mary Pinchot*, was a notable one, and although there were unfortunate delays at Panama and at the Galápagos Islands he had the pleasure and experience of seeing a considerable number of the attractive islands of the Marquesas, Tuamotus, and Society groups. Whenever there was an opportunity during the voyage Pinchot was eager to have natural-history specimens collected in the various islands. The National Museum benefited by a considerable number of specimens representing many kinds of birds, fishes, insects, and other forms, and a number of species new to science were honored by his name. His volume on this expedition, *To the South Seas* (1930), gives a good account of the daily happenings, with pictures to illustrate them.

But those who knew Gifford Pinchot long and intimately feel that the period of his life that gave him the greatest thrill and most lasting satisfaction was the dozen years he devoted to the founding of the Forest Service. They are, indeed, a monument that never will fail him.

A. K. Fisher.

Charles Albert Browne was born in North Adams, Mass., on August 12, 1870, and died in Washington, D. C., February 3, 1947. He was a descendant of the Rev. Chad Browne who succeeded Roger Williams as pastor of the first Baptist Church in America. His father, Charles Albert Browne, Sr., was a chemist who lost his eyesight as a result of an explosion in a laboratory. This calamity actually led to Dr. Browne's career in chemistry, for as a boy he had to read chemical literature to his father and thereby became so interested in the subject that he gave up plans to become a professor of Greek.

Dr. Browne was graduated from Williams College in 1892. He received his master's and doctor of philosophy degrees from the University of Göttingen, Germany. Later he received honorary degrees from Williams College and the Stevens Institute of Technology.

Before coming to the U. S. Department of Agriculture in 1923 as chief of the Bureau of Chemistry, Dr. Browne served as an instructor in chemistry at Pennsylvania State College, 1895–96; as assistant chemist of the Pennsylvania Experimental Station from 1896 to 1902; as research chemist at the Louisiana Sugar Experimental Station in New Orleans, 1902 to 1906; as chief of the sugar laboratory, U. S. Bureau of Chemistry, 1906–1907; and as chemist in charge of the New York Sugar Trade Laboratory, Inc., from 1907 to 1923.

His Federal Government positions in succession were: Chief of the Bureau of Chemistry, 1923–1927; acting chief of the Bureau of Chemistry and Soils, 1927; chief of chemical and technological research, 1927–1935, supervisor of chemical research, 1935–1940. At the time of his retirement in 1940, Dr. Browne was supervisor of research for the Department of Agriculture's Bureau of Agricultural and Industrial Chemistry. From 1940 until his death he served as a collaborator with the Bureau.

In 1906 he served as United States delegate to the International Congress of Applied Chemistry in Rome, and in 1935 to the meeting of the International Society of Sugarcane Technologists in Brisbane.

An outstanding author on chemistry, Dr. Browne's book on *Sugar analysis* is used as a standard in sugar laboratories all over the world. He wrote more than 300 papers, books, and pamphlets, including *Sourcebook of agricultural chemistry, Origin of agricultural chemistry as a science,* and *Thomas Jefferson and the scientific trends of his time.*

He won gold and silver medals for agricultural chemical exhibits at the St Louis World's Fair in 1904, an award for work on food from the Association of Grocery Manufacturers of America in 1935, and the Nicholas Appert Medal for work in food technology in 1944

He was a member of the Association of Official Agricultural Chemists, serving as its president in 1925, of Phi Beta Kappa, Sigma Xi, the American Association for the Advancement of Science, the American Chemical Society, the Washington Academy of Sciences, the International Society of Sugarcane Technologists, and the Cosmos Club of Washington. He held office in many of these organizations.

Dr. Browne was active in the enforcement of Federal and State food and drug laws. He was writing a history of the American Chemical Society at the time of his death.

Curtis J. Humphreys.

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PHYSICS.—*High centrifugal fields.*[1] J. W. BEAMS, University of Virginia.
(Communicated by KARL F. HERZFELD.)

Gravitational and centrifugal forces no doubt were recognized by man very early in his development. The gravitational pull of the earth and the centrifugal force on his body whenever he moved about in a curved path certainly were ever present. It will be recalled from studies of mechanics that the gravitational force between any two bodies is proportional to the product of their gravitational masses divided by the square of their distance apart, while the centrifugal force is equal to the inertial mass of a moving body multiplied by the square of its velocity divided by the radius of curvature of its path. Also it will be recalled that the gravitational and inertial masses of any given body are proportional. Consequently, the action of a gravitational field and a centrifugal field on matter, for most purposes at least, may be considered to be essentially equivalent (*1*). In view of this equivalence we usually express centrifugal acceleration in terms of the standard acceleration of gravity at the surface of the earth since this is one of our most familiar concepts.

The intimate contact with centrifugal force in our every-day life undoubtedly accounts for its wide use in a multitude of our activities. One of its important uses, which we shall now attempt to discuss, is the production and application of high centrifugal fields to a few problems in physics, chemistry, biology, and medicine. Space does not permit a complete review of this rapidly growing use of centrifugal fields, so a large amount of important work necessarily will have to be passed over. Emphasis will be placed upon certain problems not because they are thought to be more important than others but rather because my colleagues and I happen to have had more firsthand experience with them in our laboratory at the University of Virginia.

One important use of centrifugal fields is in the purification or separation of different substances and in the determination of particle or molecular weights, sizes, and shapes. It is, of course, common knowledge that larger particles settle out of a liquid or a gas faster than smaller ones. Just one hundred years ago Stokes (*2*) showed that the velocity of fall v of a spherical particle of density ρ_p and radius a in a liquid of density ρ_d and coefficient of viscosity η, in a gravitational or centrifugal field F, is given by the relation

$$v = \frac{2}{9\eta}\left(\rho_p - \rho_d\right) a^2 F. \qquad (1)$$

It will be observed from this relation that the rate of settling in either a gravitational or centrifugal field increases with density and with size of particle and hence may be used for separating particles of different sizes and different densities. However, from the above equation of Stokes alone, all uncharged particles or molecules in a convection-free suspension or solution might be expected to settle out after a sufficient time has elapsed. This, of course, is contrary to observation since, for example, an unsaturated solution of sugar or salt may be left to stand or centrifuged in a low-speed centrifuge as long as desired without appreciable sedimentation. This apparent absence of sedimentation is due to the fact that diffusion always opposes sedimentation. Diffusion arises from the thermal agi-

[1] The sixteenth Joseph Henry Lecture of the Philosophical Society of Washington, delivered at the meeting of the Society on February 15, 1947. Received March 5, 1947.

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tation or Brownian motion of the particles and molecules and tends to produce a transport of the particles or molecules from regions of high concentration to regions of low concentration. If the particles are large enough, their velocity of sedimentation in the gravitational field or low-speed centrifuge is much larger than their back diffusion, and so they are precipitated. However, as the size of the particle decreases the magnitude of the centrifugal force must correspondingly be increased in order to overcome the increased back diffusion. When the particle reaches molecular dimensions the centrifugal field required for appreciable sedimentation becomes quite large, but with the centrifuging technique now available appreciable sedimentation of almost any molecules or atoms can be obtained.

Unfortunately, the general theory of sedimentation in real liquids has never been worked out completely, but a good theory does exist for sedimentation in ideal incompressible liquids. Mason and Weaver (*3*) solved this problem for sedimentation in a uniform gravitational field in 1924, and Archibald solved it for sedimentation in a centrifuge in 1938 (*4*). According to Lamm (*5*) the differential equation for sedimentation of uncharged particles or molecules in an ideal, dilute, incompressible solution enclosed in a sector shaped centrifuge cell rotating with an angular velocity ω is given by

$$\frac{1}{r}\frac{\partial}{\partial r}\left\{\left(D\frac{\partial c}{\partial r} - \omega^2 r S c\right)r\right\} = \frac{\partial c}{\partial t}, \qquad (2)$$

where r is the distance of the material from the axis of rotation, c is the concentration, t the time, D the diffusion constant, and S the Svedberg sedimentation constant or the velocity of settling of the solute or particles in unit centrifugal field. Faxen (*6*) and Soyten (*7*) each have given approximate solutions to this equation, and Archibald has given the general solution. Recently Archibald has greatly simplified the calculations necessary in applying the theory to experimental results (*8*). Many years ago Svedberg (*9*) derived the equations for sedimentation in a sector-shaped centrifuge cell (equation 2 above) for two most important special cases. In the first case he assumed that if the centrifuging process is continued long enough, diffusion will exactly balance the sedimentation and equilibrium will be established, [i.e., $\partial c/\partial t = 0$, and the change in free energy throughout the centrifuge vanishes. This gives

$$M_e = \frac{2\,RT\,ln\,c_1/c_2}{(1 - V\rho)\omega^2(r_1^2 - r_2^2)} \qquad (3)$$

and

$$V_e = \frac{2\,RT\,ln\,c_1/c_2}{N(\rho_p - \rho_d)\omega^2(r_1^2 - r_2^2)}, \qquad (4)$$

where M_e is the particle or molecular weight, V_e is the volume of the particle or molecule, c_1 and c_2 are the concentrations at distances r_1 and r_2 from the axis of rotation, respectively, ρ, ρ_p, and ρ_d are the densities of the solution, particle and solvent respectively, V is the partial specific volume of the substance, R is the gas constant, N is the Avogadro number, and T is the absolute temperature. It will be observed that equation (3) is merely the statement of the Maxwell-Boltzmann distribution in the centrifugal field. It subsequently has been derived from thermodynamic reasoning by Svedberg and Tiselius. If the solution is an electrolyte which dissociates into m n-valent cations and n m-valent anions, where the numbers n and m contain no whole number factor,

$$M_e = \frac{2(m + n)\,RT\,ln\,c_1 f_1^{\pm}/c_2 f_2^{\pm}}{(1 - V\rho)\omega^2\,(r_1^2 - r_2^2)}, \qquad (5)$$

where $f_1^{\pm}$ and $f_2^{\pm}$ are the activity coefficients (*10*). In most cases where the molecular weight is comparatively large and the solutions are not at the isoelectric point, or where the particles are charged, the electrostatic effects of the ions can be repressed by the addition of a low molecular weight electrolyte such as NaCl and the simpler equations (3) and (4) may be used instead of (5). Electrical charges on the sedimenting particles always reduce the velocity of sedimentation. In case the solute is ionized the sedimentation of the heavier ion is decreased and that of the lighter ion is in-

creased since the heavier ion drags the lighter ion along with it. When the centrifugal field is first applied to a solution containing ions an electrical potential appears between the axis and periphery. This electrical potential decreases as the sedimentation continues and vanishes when equilibrium occurs (*11*, *12*).

In applying the above equations the concentrations and temperature are measured under equilibrium conditions, and hence to a first approximation the values of M_e are independent of particle or molecular shape. The partial specific volume V is usually measured outside the centrifuge and does not take account of hydration or solvation effects. However, Lamm (*10*), Kraemer (*10*), Pickels (*13*), and their collaborators have shown how to correct for these effects and have found that, in most practical cases, the correction is comparatively small, although there are exceptions. In cases where the centrifuge cell contains a solution with a number of different solutes equation (3) gives the concentration of each substance independently of the others as a function of the radius provided the solution is sufficiently dilute. Consequently by measuring the concentration in the centrifuge cell at a number of different radii, it is possible to determine the distribution of particle weights in the solution.

Although the above equilibrium method of equations (3), (4), and (5) gives most reliable values for M_e and V_e, the centrifuging time required for equilibrium to be established is very long when the molecular weight M_e is large. In fact, for many of the biologically important substances which have large molecular weights, this equilibrium time is of the order of several days or weeks.

In order to avoid this long centrifuging time Svedberg (*9*, *20*) devised the rate of sedimentation method which is especially applicable to the measurement of the molecular weights and sizes of large molecular weight substances. In this rate of sedimentation method both the molecular weight and centrifugal field must be large enough to produce a sedimentation velocity that can be measured directly. If the particles or molecules are uncharged and the solution is ideal and dilute and if the experimental conditions are such that molecular or particle reflection from the ends of the sedimenting column can be neglected, then the sedimentation force per mole may be equated to the frictional force per mole

$$M_s(1 - V\rho)\omega^2 r = f\frac{dr}{dt}. \qquad (6)$$

The frictional force $f = RT/D$ where D is the diffusion constant. This gives for the molecular weight M_s

$$M_s = \frac{RT}{D(1 - V\rho)}\frac{dr/dt}{\omega^2 r} = \frac{RT}{D(1 - \rho V)}S, \qquad (7)$$

where S is the velocity of sedimentation in a unit field, and is usually expressed in Svedberg units, i.e., in units of centimeters per second per unit field of force multiplied by 10^{13}. Actually most of the values given for S have been reduced to the equivalent velocity of sedimentation S_{20} in water at 20°C by the relation

$$\frac{S_t}{S_{20}} = \frac{\eta_{20}}{\eta_t}\frac{1 - V_t\rho_t}{1 - V_{20}\rho_{20}}.$$

In this method each molecular species gives rise to an easily distinguishable boundary between the solvent and the sedimenting column so that dr/dt and hence S can be quite accurately measured. As the time of centrifuging increases, this sedimenting boundary becomes progressively blurred because of diffusion. However, for a comparatively large molecular weight substance, this blurring is small, and furthermore diffusion theory shows that the position which the boundary would have occupied had there been no diffusion is the place where the concentration is one half that in the unaffected sedimenting column adjacent to the boundary. The concentration in the column of sedimenting material decreases slowly as the centrifuging progresses since the particles move out along the radius and hence diverge. Also the centrifugal field increases toward the periphery which

in turn increases the rate of sedimentation and hence reduces the concentration in the sedimenting column. If c_o is the original concentration and c_t is the concentration at any time, t, then Svedberg and Rinde (*9*, *10*) have shown that

$$c_t = c_o \frac{r_o^2}{r_t^2} \tag{8}$$

where r_o is the radius of the meniscus and r_t is the radius of the boundary at the time t. When the solution contains several sedimenting substances, each forms its characteristic sedimenting boundary so that a molecular weight analysis of the solution is automatically obtained. Also if the solution contains a distribution of molecular weights and sizes rather than a homogeneous molecular species, the rate of sedimentation method can give this distribution.

It will be observed from equation (7) that in order to get the molecular weight M_s the diffusion coefficient D must be measured. This may be carried out either during the centrifuging process or in separate experiments. Both methods give essentially the same results so the latter method is often used. If the particles or molecules are known to be spherical and hydration effects can be neglected, the frictional constant f_o can be calculated from the following equation of Stokes:

$$f_o = 6\pi\eta N\left(\frac{3MV}{4\pi N}\right)^{1/3}, \tag{9}$$

which when substituted into equation (6) gives the molecular weight M. The ratio of the measured frictional constant f of equation (6) to the calculated value f_o [equation (9)] is always equal to or greater than one. If the amount of hydration is known the approximate shape of the molecules or particles can be estimated.

The equilibrium method [equation (3)], which has its greatest application in the smaller molecular weight range, and the rate of sedimentation method [equation (7)], which is adapted principally to the larger molecular weight range, recently have been supplemented by a method made possible by the solution of equation (2) by Archibald. Archibald (*8*) has put the results of his mathematical solution in a convenient form for use, and it is hoped that it will provide increased reliability for the results especially in the large molecular weight range.

Although the above outline of the theory is very brief and incomplete, it does show that a sufficiently powerful centrifuge may be used as an analytical tool for the determination of particle or molecular weights, sizes, and shapes or that it may be utilized for the purification of materials or the separation of a mixture into its various pure components. The value of this tool in biological, and medical research is enhanced by the fortunate fact that most of the biological compounds in solution are not deactivated by high centrifugal fields so that the measurements obtained are for this material in its natural state.

For analytical work the centrifuge must produce a centrifugal field sufficiently intense to give an appreciable sedimentation and the solution being centrifuged must be convection free. It can be shown that in order to meet the latter requirement the centrifuge cell should be sector shaped so that the sedimenting particles can all move freely in the direction of the centrifugal field and that the centrifuge cell should be at as nearly uniform temperature as possible.

Svedberg Ultracentrifuges

Svedberg and his associates not only pioneered in the use of the convection free centrifuge for analytical work, but they have provided us with a major portion of the molecular weight data obtained so far by the centrifuge method (*10*). No attempt will be made here to discuss the Svedberg ultracentrifuges, since they are described in detail in a book by Svedberg and Pederson (*10*), except to mention that they consist of two principal types. The first type develops comparatively low centrifugal fields (500 to 15,000 g). It is driven by an electrical motor and supported in ball bearings. The rotor spins in hydrogen and carries a sector-shaped cell with quartz windows which contains the material to be centrifuged. The sedimentation is viewed optically through the quartz windows. This type of ultracentrifuge is used principally

for sedimentation equilibrium measurements. The second type of ultracentrifuge develops much higher centrifugal fields (15,000 to 750,000 g) and is driven by twin oil turbines. The material being centrifuged also is contained in a sector-shaped cell, which has quartz windows so that the sedimentation can be recorded by optical methods. The rotor is surrounded by hydrogen at about 20 mm pressure which conducts the heat generated by the friction in the bearings, by gaseous friction on the rotor, and by oil impinging on the turbines, to the casing. This type of ultracentrifuge has been used primarily for rate of sedimentation measurements.

Air-driven Vacuum-type Ultracentrifuge

The vacuum-type air-driven ultracentrifuge originally was developed to avoid the troublesome effects of air or gaseous friction on high-speed rotors or centrifuges (*14*, *15*, *16*) This gaseous friction at high rotor speeds not only consumes a large amount of power but also it heats the centrifuge rotor. This heating of the centrifuge rotor is greater on the periphery than on the axis, and thermal gradients in the rotor are set up which cause convection in the centrifuge cell. Since the forces that produce this convection increase with the centrifugal field thermal gradients necessarily should be as small as possible if the data are to be reliable. Essentially this machine consists of a large centrifuge rotor located inside a vacuum-tight chamber, a small air-driven air-supported turbine situated above or below the chamber, and a thin flexible shaft which fastens them together and which is coaxial with their common axis of rotation. Several variations in the design of these convection-free vacuum-type ultracentrifuges are in use by different workers (*16*), but Fig. 1 gives a diagram of a machine used at Virginia for analytical work which will serve to illustrate the principles of the apparatus (*17*). The rotating members consist of the flexible steel shafts A (0.1 inch) and A'(0.1 inch), the driving turbine T, the centrifuge rotor RA, and a magnet M. The shafts are vertical and coaxial and turn in the hard babbitt bearings G_1, G_2, G_3 and a very loose (15-mil clearance) sliding guide SB. G_1, G_2, and G_3 are mounted in flexible round neoprene rings and are oil sealed. G_3 is lubricated and sealed with a low vapor pressure oil so that a good vacuum can be maintained in the steel vacuum chamber V. The guide bearing SB serves to prevent "swinging" of the rotor at low rotational speed. At running speed the shaft A' runs free without touching in the 15-mil clearance. The rotating members are supported by an air-thrust bearing formed between the Bakelite collar B and the turbine T. This collar is fastened to a flexible neoprene support D. The centrifuge rotor RA is a Duralumin analytical rotor with the cell C, which contains the solution to be centrifuged 65 mm from the axis of rotation. Fig. 2 shows a picture of this rotor and the cell. The rotor is made oval shaped to increase its strength, and the cell is sector shaped with crystal quartz windows cut perpendicular to the optic axis for observing the sedimentation optically. The permanent magnet M together with the field FC provides a speed control for the ultracentrifuge. M is a magnetized, hardened steel rectangular bar $1\frac{1}{2}$ inches long, $\frac{1}{2}$ inch wide, and 9/16 inch high. It has a hole in the center for the shaft A, to which it is rigidly attached by set screws or a steel clutch. The field coils FC consist of a large number of turns of well-insulated copper wire wound on a laminated field core. The laminations were (0.02 to 0.0075 inch thick) silicon steel laminations to give a total thickness of 9/16 inch. The copper wire was no. 21 enameled, and sufficient turns were used to give an inductance greater than 30 millihenrys for the coils connected in series.

To operate the centrifuge the vacuum chamber V and rotor RA are first thermostated to the desired running temperature. The material to be centrifuged is then placed in the vacuum-tight centrifuge cell which is tightly sealed and placed in RA. Electrical condensers are next connected in series with the field coils FC, which possess the proper capacity to make the circuit resonate at a frequency slightly above the desired running speed. Oil is next forced into G_1, G_2, and G_3 and the vacuum chamber V evacuated to less than 10^{-5} mm Hg through

P. Compressed air then is applied through *SI* to the air support at a pressure (10 to 15 lbs/in^2), which allows the rotating members to turn freely. The driving air is next admitted through *DI* to the turbine *T*, and the centrifuge starts spinning. The centrifuge will continue to accelerate until electrical resonance starts in the circuit. The rotating magnet *M* induces an e.m.f. in the field coils with a frequency equal to its frequency of rotation, but the current in the circuit is negligible until the circuit starts resonating. When resonance starts the current in the circuit increases abruptly and the reaction is such as to brake the magnet. If now the air pressure to the turbine is set a few lbs/in^2 above that necessary to maintain this speed of the centrifuge, the resonant circuit will absorb the surplus energy, and the rotor speed will be maintained constant. In practice, with an ordinary air-pressure regulator in the air line, the speed of the centrifuge automatically remains constant to less than 0.1 per cent as long as desired. Also, if no changes are made in the driving air pressure or circuit, the rotor speeds will check to about 0.1 per cent on successive runs. An idea of the critical braking action of this speed control can be obtained from the fact that, in our experiments, doubling the driving air pressure increased the rotor speed (at about 1,000 r.p.s.) by less than 1.5 per cent. Also our air turbines are not able to drive the centrifuge through resonance with six times the normal driving air pressure, which was all we had available on our pressure line. It will be observed that no over-heating occurs when energy is absorbed in the control due to the fanning action of the magnet *M*.

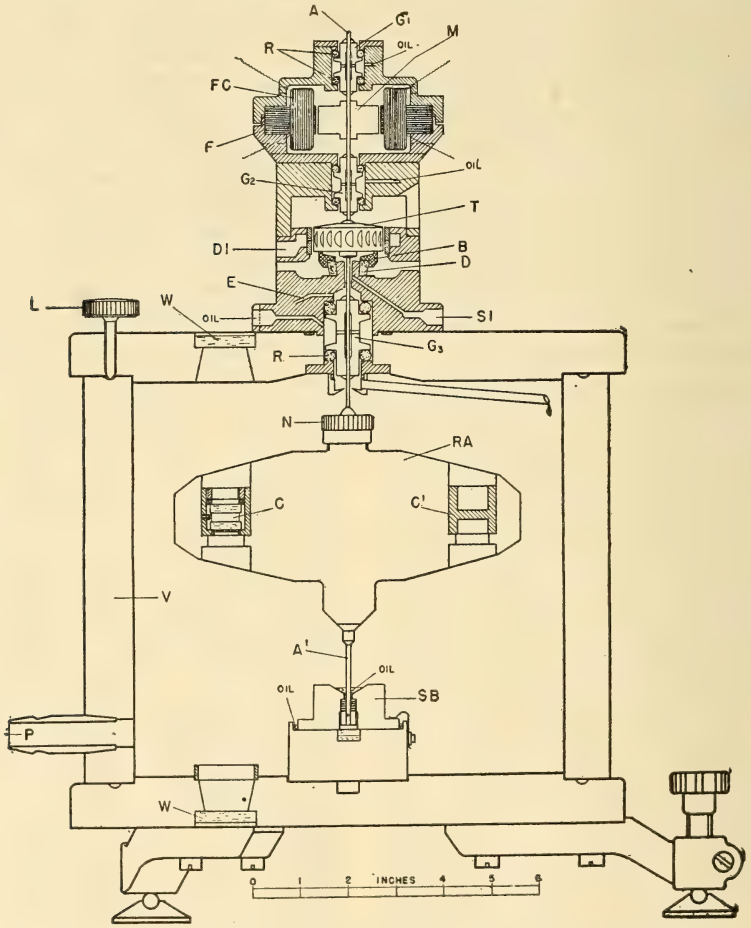


FIG. 1.—Air-driven air-supported vacuum-type ultracentrifuge with speed control.

Also any heat from the control is isolated from the vacuum chamber by the air passing through the air turbine below it. It should be pointed out that the only factor that limits the maximum centrifuge rotor speed is the mechanical strength of the rotor. Clearly the running speed can be set anywhere below this value. Since the centrifuge rotor spins in a good vacuum, no appreciable heat is developed and hence no temperature gradients are formed in the centrifuge cell. In some experiments hydrogen at a pressure of a few mm of Hg has been used to surround the rotor. In these experiments it was desirable to have a good thermal connection between the vacuum chamber walls V and the rotor. The low viscosity and hence low resultant rotor friction of hydrogen together with its comparatively large heat conductivity make it the best gas to use for this purpose. If the pressure of the hydrogen in V is not over a few mm Hg, convection-free sedimentation is obtained.

Several methods are available for measuring the concentration or sedimentation in the centrifuge cell optically. Most of these methods make use of the fact that the solute has a different absorption spectrum than the solvent or they employ the gradient of the refractive index in the cell. For many proteins, in order to get sufficient differential absorption, ultraviolet light must be used. This requires quartz optical parts throughout and hence is rather expensive. However, for the refractive index gradient methods, glass is used. Except in certain special cases the refractive index methods are preferable and a number of modifications of it are in use. Lamm (*18*, *10*) developed a method in which a scale is photographed through the centrifuge cell. From the distortions in the images of this scale the refractive index gradient is determined. Philpot (*19*), Svensson (*20*), Anderson (*21*), Pickels (*13*), Williams (*22*), and others have used methods based upon the Toepler schlieren idea. Special tests carried out by Pickels showed that deviations of the light beam produced at any level of the centrifuge cell (at least up to 0.02 radian) can be determined photographically with a precision of less than 1 per cent and that the image positions of every radial distance in the cell can be produced with an accuracy of less than 1 per cent of the total centrifuge cell height. In our laboratory at Virginia, I. Foster is using a Jamin interferometer method for measuring the sedimentation in very dilute solutions. It is obvious, of course, that other than optical methods may be used for measuring sedimentation such as the radioactive radiations from atoms tagged to the sedimenting molecules, etc. It will be recalled that the present theory of sedimentation holds only for dilute solutions, therefore it is important in some cases at least to use a method of recording the sedimentation in as dilute solutions as possible. There is indeed a genuine need for better methods of recording sedimentation in very dilute solutions than are in use at present.

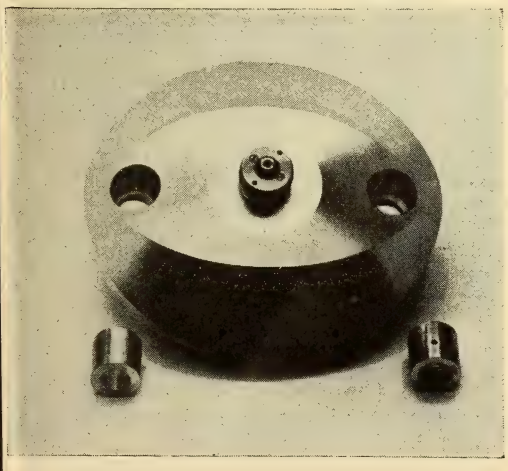


FIG. 2.—Analytical ultracentrifuge rotor.

ELECTRICALLY DRIVEN MAGNETICALLY SUPPORTED VACUUM-TYPE ULTRACENTRIFUGE

The air-driven air-supported vacuum-type ultracentrifuge just described possesses practically all of the desirable features of an ideal centrifuge. However, it requires a supply of compressed air, which is not always readily available. Also a noisy air compressor is sometimes a nuisance to be avoided. Because of this we (*23*, *24*, *16*) developed at Virginia before the war the electrically driven magnetically

supported vacuum-type ultracentrifuge shown in Fig. 3. The rotating components consist of the steel motor armature D, the steel magnetic support core R, the flexible shaft A, and the centrifuge rotor C. The shaft is hollow from G_3 to G_2, through which cooling water passes. The rotor C, flexible shaft A, vacuum chamber V, and oil glands G_1 and G_2 are the same as in the air-driven vacuum-type centrifuge described previously. The only differences are that an electrical motor is substituted for the air drive and a magnetic support is used instead of an air support. The small remaining weight is carried by a small thrust bearing consisting of the upper babbitt surface of G_3 and a small collar on the shaft. This small oil thrust bearing is designed to support the total weight of the rotating system in case the power supply of the lifting solenoid should fail. This type of magnetic support is almost friction free. The four field coils F of the motor are supplied with a high-frequency 2-phase alternating current in such a way that the field rotates with the same frequency as the alternating current. This rotating field induces currents in the steel armature D and causes it to rotate. This type of induction motor is well suited to this problem because a comparatively large starting and accelerating torque exists. Several ways may be used to produce the alternating power required. At Virginia an electronic generator is used with which the rotational speed of the centrifuge remains constant to 0.1 per cent as long as one desires. Fig. 4 shows a couple of rotor speed versus time curves taken on successive days. The entire apparatus operates from the 110-volt AC lines and is automatic. With the 6-inch Duralumin rotor of Fig. 3 weighing about 9 pounds, 1 kilowatt input to the motor at a frequency of 1,180 cycles per second accelerated the rotor to 1,000 r.p.s. in a little over 15 minutes, which compares favorably with the air drive. The power input to the motor required to maintain the speed constant at 1,000 r.p.s. was less than 500 watts.

The precision with which molecular weights can be measured with the air-drive (Fig. 1) and electrically driven (Fig. 3) centrifuges is about the same. In most experiments the rotational speed can be measured to 0.1 per cent, the temperature to about 0.1°C, and the rate of sedimentation to at least 1 per cent. In the equilibrium method the ratio of the concentrations at the various radial distances of the cell can be measured to less than 1 per cent and the temperature and rotor speed held constant for the run to at least 0.1 per cent. The most uncertain element in the molecular weight determination of ultracentrifugation is in finding the true value for the partial specific volume V. As pointed out before this arises from the uncertain knowledge as to the amount of hydration or solvation present. There is urgent need for a reliable method of determining V in the actual solution. The three centrifuge methods, including the equilibrium, the rate of sedimentation, and the new method which makes use of Archibald's solution of equation 2, provide comparatively good molecular-weight data over a range in

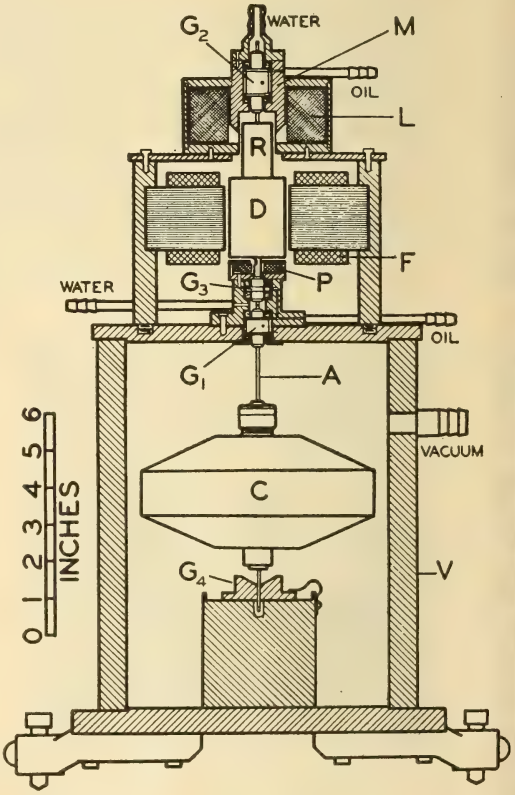


FIG. 3.—Electrically driven magnetically supported vacuum-type ultracentrifuge.

molecular weights from the lightest to the heaviest molecules known. The first equilibrium method (equations 3, 4, and 5) is used primarily for molecular weights below about 10,000, while the latter two methods are best suited for molecular weights above 10,000.

From the standpoint of biophysics, one of the most interesting facts that have come out of the molecular-weight data is the apparent existence in nature of very high molecular weight homogeneous compounds. Some of these compounds have molecular weights that exceed 10^7 molecular-weight units. These compounds are quite stable and, in some cases as far as can be determined, are composed of a single molecular species in which each molecule has exactly the same mass. Not all of these naturally occurring substances such as keratin, fibroin, and myosin are composed of homogeneous molecular species, but most of the easily soluble proteins have definite molecular weights. In some cases such as the respiratory proteins, which have been extensively studied in the analytical ultracentrifuge, the molecules dissociate into submultiples. For example, when a solution of haemoglobin is made very dilute, the molecules split into halves. In the case of a haemocyanin (*Helix pomatia*) solution at the isoelectric point, whole molecules exist alone with molecular weight of 8.9×10^6 provided the salt concentration is not too high. When the solution is made weakly acid, half molecules appear. If it is made alkaline, half molecules appear first followed by molecules one-eighth the original molecular weight, etc. Within the region of *p*H 4 to *p*H 9 the dissociation is reversible and the whole molecules will be reformed at the isoelectric point. In the case of some proteins Svedberg and, more recently, Pedersen (*10*) have interpreted their molecular-weight data as indicating that certain proteins they have studied have molecular weights that are integral multiples of 17,600. In other words, the building blocks of these proteins have a mass of 17,600 molecular-weight units. These conclusions have been questioned by a number of workers (*25*, *26*) on the ground that the molecular-weight data are not good enough definitely to prove that the 17,600 unit exists. Whatever may be the answer to this most interesting and important suggestion of Svedberg, all workers in the field will agree that it would be highly desirable to obtain more precise data if it is possible. For example, an error of ± 1 per cent in a molecular weight of 10^7 is $\pm 10^5$ molecular units. Just before the war some experiments (*27*) were started at Virginia with the hope of examining more closely the homogeneity of some of these proteins, but these have been interrupted until the past few months.

Several alternate methods were considered including the electron microscope. This beautiful method, while giving the shape of the largest molecules, has its precision

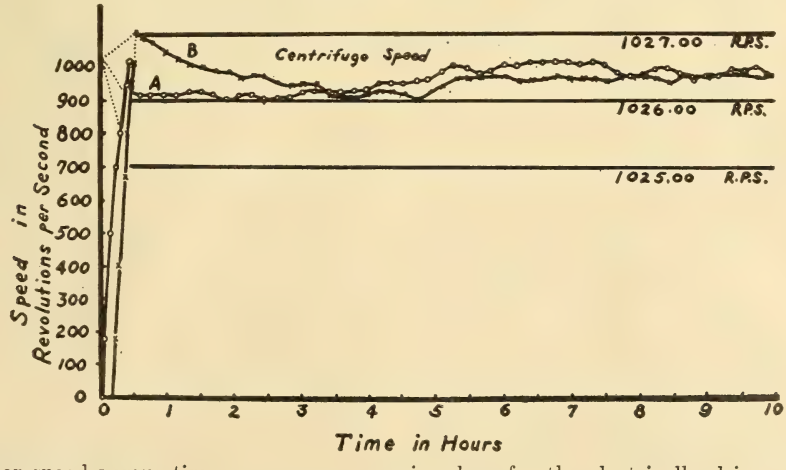


FIG. 4.—Rotor speed versus time curves on successive days for the electrically driven magnetically supported ultracentrifuge.

limited by a resolving power of from 10 to 20 Ångstroms (*28*). It also may deactivate the molecules under study. Therefore it seemed necessary to reexamine the centrifuge method, especially since the electron microscope technique was being vigorously pursued elsewhere.

In the rate of sedimentation method the resolving power or ability of the centrifuge to resolve two molecular species is approximately proportional to $\omega^2 rh$ where $\omega^2 r$ is the centrifugal field and h is the height of the cell. The strength of a centrifuge rotor is roughly proportional to $\omega^2 r^2$ where ω is the angular velocity and r is the radius of the rotor. In practice $\omega^2 rh$ is very roughly proportional to $\omega^2 r^2$, and so the resolving power is proportional to the bursting strength of the centrifuge rotor. Therefore, since, in the present centrifuges, the rotor speed is limited only by the strength of the rotor, there does not seem to be much promise of increasing the resolving power by increasing the rotor strength at least until better rotor material is available. However, if we let T be the time that the sedimenting boundary remains in the field of view of the centrifuge cell, the resolving power becomes $(\omega^2 r)^2 ST$ or directly proportional to T. Now it is possible to increase the time T by flowing the solvent through the centrifuge cell at approximately the same speed with which the material settles out. This makes it possible to keep the sedimenting boundary in the field of view for long periods of time, thus greatly increasing the resolving power of the machine. Fig. 5 shows a schematic diagram of the arrangement in which the straight schlieren method is used for observing the sedimenting boundary. The solvent is injected at a controllable rate through the axis of the spinning centrifuge and flows through the centrifuge cell from the periphery toward the axis where it is collected in a large cavity in the rotor. If there is any nonhomogeneity in the substance being centrifuged, or if it consists of two or more

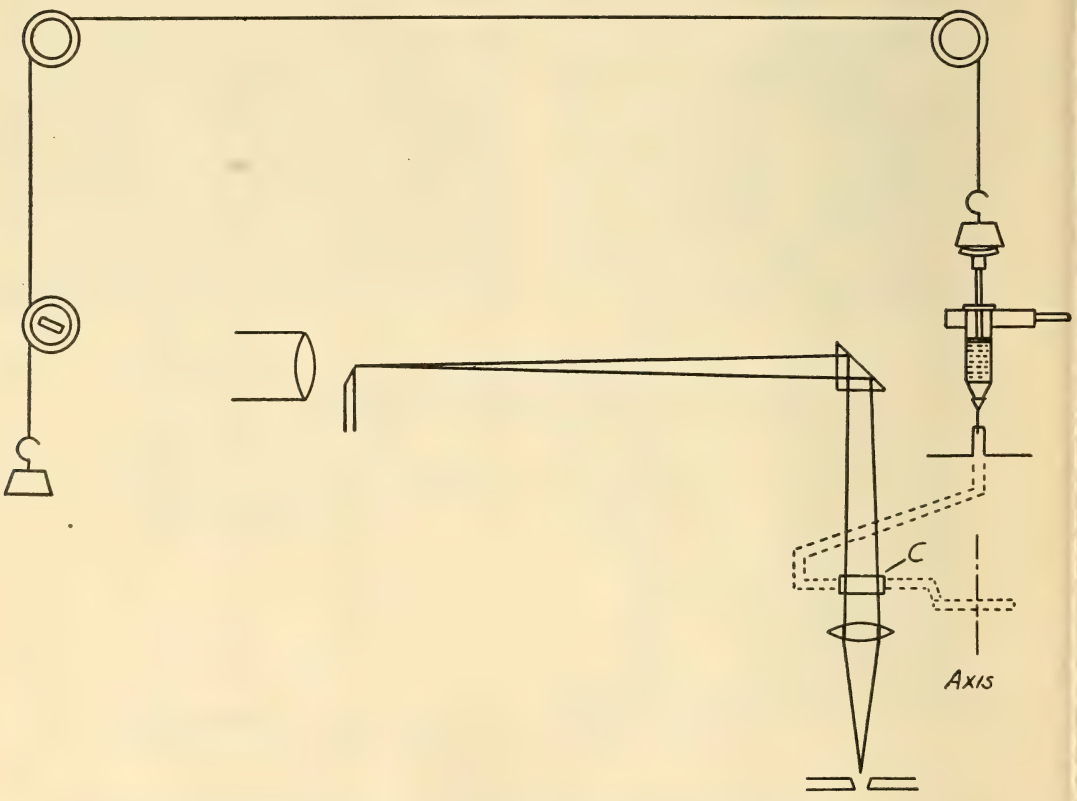


FIG. 5.—Schematic diagram of high-resolving-power ultracentrifuge.

molecular species, the sedimenting boundary will blur or split up into two or more sedimenting boundaries respectively. In some preliminary experiments haemoglobin was apparently homogeneous to at least 50 molecular-weight units. The ultimate limiting factor with the method seems to be a gradual dilution produced by the effect described in equation (8), but, with better optical methods of measuring sedimentation in dilute solutions, the method has promise of precision much greater than any yet obtained.

A second method of testing the homogeneity of large molecular weight substances also is being developed at Virginia. In this method the sedimentation in the cell is balanced by electrophoresis. Electrodes are placed in the centrifuge cell in such a way that a current can be passed through the cell along the radius. The solution containing the materials to be centrifuged is brought to a *p*H value not on the isoelectric point. The centrifuge is then spun to full speed and sedimentation allowed to take place until the sedimenting boundary moves to the middle of the cell. The electrical current is then passed through the cell in such a direction that this boundary remains stationary. Under these conditions, if the solute that forms the sedimenting boundary is either nonhomogeneous or composed of different molecular species, the sedimenting boundary will no longer remain sharp. Also, if the molecules or ions in the sedimenting columns have different electrical charges, the sedimenting boundary will split up or become blurred. It may be noted that the molecule or ion in the sedimenting boundary under observation remains stationary with respect to the centrifuge cell and therefore the hydration or solvation of the ion is ineffective. Experiments with haemoglobin have indicated that the boundary will remain sharp for considerable periods of time. The liquid column in the cell may be stabilized to a considerable extent by the fact that the heat generated by the electrical current through the cell is less near the periphery than near the axis because of the sector shape of the centrifuge cell.

The high-speed centrifuge not only may be employed as an analytical tool as discussed above but also it may be used as a means of purifying or separating substances that have different rates of sedimentation or different densities. As a matter of fact, this latter function is perhaps more important than the former. A great many substances of utmost importance in biology and medicine exist in nature in very dilute solution and in mixtures. In order properly to study these substances, it is usually necessary to purify and concentrate them by some means which does not destroy their biological activity. Often comparatively small changes in *p*H or temperature will destroy them so that the usual chemical means of concentration cannot be used. However, as mentioned previously, a high centrifugal field does not seem to deactivate them in any way; also the temperature and *p*H in the vacuum type ultracentrifuge can be accurately adjusted to any desired value within the working range. In most cases it is desirable to centrifuge comparatively large amounts of the natural solution in order to obtain a sufficient quantity of the purified substance to carry out the desired experiments.

The vacuum-type high-speed ultracentrifuges described in Figs. 1 and 3 may be used for the purification or concentration of substances instead of as an analytical centrifuge by simply removing the analytical centrifuge rotor from the shaft and placing a so-called angle "quantity type" or "preparation type" centrifuge in its place. Several types of angle "quantity type" rotors have been used successfully by a number of different workers, and Wyckoff (*30*), Pickels (*31*), Rosenfeld, Masket (*32*), and others (*16*) have studied the process by which the sedimentation takes place. Fig. 6 shows a cross section of an angle "quantity type" centrifuge rotor developed by Masket (*32*), at Virginia, which has proved highly efficient and easy to construct. These rotors are usually made of a solid block of Duralumin ST 14. The tubes *T*, which contain the material to be centrifuged, are bored at an angle of about 12° with the vertical and are drawn to scale in Fig. 6. A Lusteroid tube which fits snugly into *T* is completely filled with the

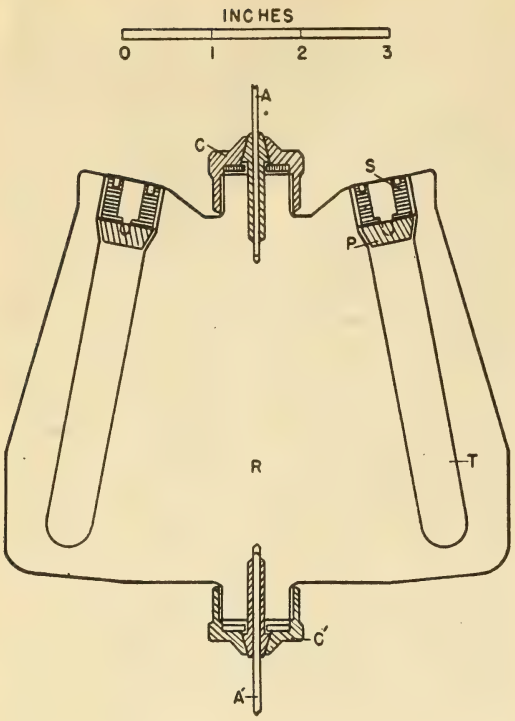


FIG.6.—Preparative or "quantity" type ultracentrifuge rotor.

solution or suspension to be centrifuged. A leak-tight plug P is forced into T and the screw S tightened until a leak-tight seal is made. The tubes T are accurately spaced so that the rotor is in good dynamical balance when either full or empty. The rotor shown in Fig. 6 holds about 100 cc when all the tubes are filled, and the maximum centrifugal field in the cell is about 300,000 gravity. With the apparatus of Figs. 1 and 3, the strength of the rotor Fig. 6 is the only factor that limits the rotor speed and centrifugal field. The strength of a homogeneous centrifuge rotor depends not on its absolute strength directly, but upon this divided by the density of the rotor material. This is not quite true for the rotor of Fig. 6, which carried 100 cc of solution, but it is roughly correct. Duralumin ST 14, therefore, is almost as good as steel and possesses the added advantage of being machinable after heat treatment. Also it is considerably lighter, which allows it to be accelerated rapidly and lessens the damage done if an accidental explosion occurs. On the other hand, for the substances of lower molecular weights, high strength steel no doubt could be used to a considerable advantage. The sedimentation that takes place in the tubes T is not completely convection free as in the case of the analytical rotors, but what convection exists aids the separation instead of hindering it. The material settles out almost to the outer wall and thus increases the density in this outer region. The force on this concentrated solution is then such as to cause is to move down to the bottom of the tube where it settles out. Several of the viruses actually crystallize out in the bottom of the tube. After the sedimentation is completed, the centrifuge rotor is allowed to decelerate to zero. The rotor may be decelerated rather rapidly down to about 300 r.p.s. and then move slowly on down

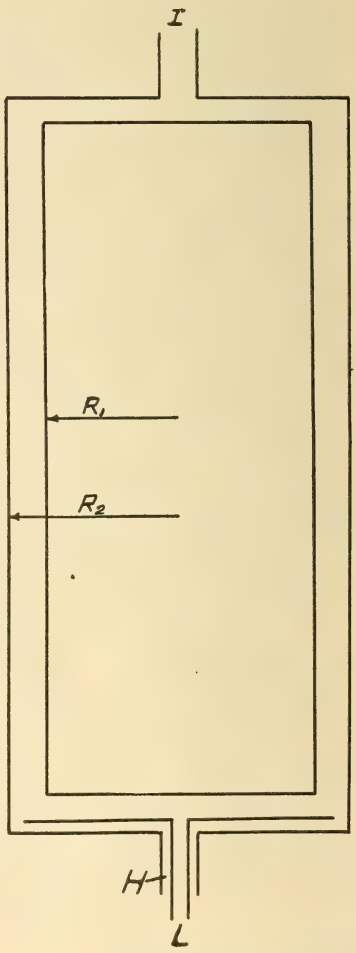


FIG. 7.—Schematic diagram of tubular centrifuge rotor.

to rest. The deceleration must be smooth in order to avoid remixing. The Lusteroid tubes which contain the material to be centrifuged are carefully removed from the rotor and placed in a vertical holder. The lighter fractions are then drawn off through a hypodermic needle or other arrangement which does not stir or remix the contents of the tube. Sometimes, when no material is actually deposited on the bottom of the tube, a method of displacement with a heavier nonmixable liquid may be used to separate the lighter from the heavier fractions. Pickels (*31*), Masket (*32*), and others have shown that a fairly precise analysis of the molecular weights of the substances being centrifuged can be obtained if this procedure is carried out with care. This analytical technique is most useful in many cases where the substance being concentrated is a very dilute active agent whose absorption spectrum or other optical properties are unknown.

In many cases it is desirable to process a very large volume of material, and then the above "quantity type" of high-speed centrifuge becomes impracticable. About 10 years ago at Virginia we attacked this problem by means of a continuous-flow tubular high-speed centrifuge (*16*). This work was dropped in 1940 because of the war and has not as yet been taken up again, although the results showed that the method was strikingly successful.

Fig. 7 shows a schematic diagram of the tubular centrifuge rotor used. This rotor consists of two concentric steel cylinders with radii R_1 and R_2 and length L. The inner cylinder is solid steel. The material to be centrifuged enters at I and then flows vertically down the annular space between the two cylinders where sedimentation takes place. The light fraction emerges through L and the heavy fraction through H. If the inner wall of the outer cylinder is accurately cylindrical some of the heavy material settles out on the wall, but if it is slightly cone shaped with the apex of the cone toward the top, the concentrated material will move down along the wall and if the exits are properly made will emerge through H, provided of course the concentration is not allowed to become so great that it clogs the outlets. However, in most practical cases, the sedimented material is in dilute solution and it is desirable to have the concentrated material deposited on the wall. In practice, H is plugged and this material is deposited in a smooth film or coating on the inside of the outer cylinder and does not interfere with the sedimentation until it becomes too thick. At this stage the centrifuge rotor is stopped and the film may be ripped or scraped off of the wall and the rotor again put into operation. If the solution contains two materials which are sedimented out, the deposit on the top of the cylinder contains a larger percentage of the heaviest of these materials while the deposit on the bottom part of the cylindrical surface contains mostly the lighter component. Consequently by proper adjustments, the various components can be purified. Also from an analysis of this deposit as a function of the distance from the top of the cylinder an estimate of the sedimentation constants S_1 and S_2 and hence the molecular weights M_1 and M_2 of the two substances respectively can be obtained. If the solution contains an uncharged homogeneous molecular species as a solute with a sedimentation constant S, and if all this solute is deposited on the inner cylindrical wall of radius R_2, then the amount of solution F, in which the centrifuge can completely remove all of the solute per second, is approximately (*16*):

$$F = \frac{\pi L \omega^2 S}{2}\left(R_2 + R_1\right)^2. \qquad (10)$$

From this it can be seen that with the tubular centrifuges we described about 10 years ago, when we were working on this problem, one tubular centrifuge was equivalent to about 40 machines of the "quantitative type" of Fig. 6. Therefore this type of tubular centrifuge should be used when large quantities of material are to be processed.

If only very small quantities of solution are available the tubes T in Fig. 6 should be reduced in size so that they are always filled. Whenever possible, the vacuum-type centrifuge should be used because of the absence of thermal gradients. However, if

the material has a sedimentation constant above about 4 to 5 Svedberg units and only a very small amount of solution is available a rotor similar to Fig. 6 may be mounted on a small air-driven turbine shown in Fig. 8. Such apparatus is easy to make and costs only a few dollars (*16*). However, extreme care must be taken in stopping the rotor to prevent remixing. Also we have found that an artificial radial temperature gradient (decreasing from axis to periphery) introduced by focusing a hot-pointed heater on the region near the axis of the rotor tends to stabilize the sedimentation. Such thermal gradients also may be introduced by electrical means into the vacuum-type centrifuge rotors if desired, but if the pressure is below 10^{-5} mm Hg or if hydrogen at a pressure of less than a millimeter of Hg surrounds the rotor it is unnecessary. Also the vacuum-type ultracentrifuge can easily be operated between 4°C and 0°C, over which range in aqueous solution an increase of temperature increases the density, so the periphery may be made warmer than the axis of the rotor.

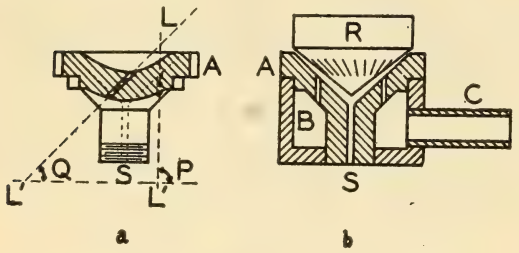


FIG. 8.—Small air-driven air-supported centrifuge.

In equation (6) it will be observed that if $V\rho = 1$ then $dr/dt = 0$ and the sedimentation stops. In other words, no sedimentation takes place if the density of the solvent ρ_d and the density ρ_p of the solute are exactly the same. Consequently, if a radial density gradient exists in a centrifuge cell over a range of densities which would include the density ρ_p of the solute, then the solute will seek a radial level in the centrifuge where the density of the solution ρ coincides with ρ_p. Clearly the sharpness of this radial level gives a measure of the homogeneity of the material being centrifuged. Also the density $\rho = 1/V$ can be determined directly. The value of the partial specific volume V obtained in this way clearly may not be the same as the value of V in dilute solution due to possible changes in hydration brought about by the material added to the solution to increase its density. In the case of proteins, the value of ρ_p in the unsolvated state is about 1.3 gm/cc although values from 1.1 to 1.5 gm/cc have been reported. Hence in order to carry out experiments with proteins, a comparatively low molecular weight inactive material must be added to the water solvent such as pure sugar.

The radial stratification of substances of different densities can be carried out very conveniently with the vacuum-type centrifuges of Fig. 1 where the process can be observed. The smallest density gradient is set by the compressibilities of the solvent and solute where a pure liquid solvent is used, but where other low molecular weight substances are added, the major portion of the density gradient can be calculated by equation (3), since equilibrium must exist before a stable density gradient is established. With the vacuum type of centrifuge rotor of Fig. 1, the radial density gradient in the centrifuge cell which contains pure water is approximately 1 per cent per cm with a rotor speed of 1,000 r.p.s. E. N. and E. B. Harvey, H. W. Beams, and others have discussed the possibility that this density gradient centrifuge method might be used for the separation of the chromosomes and other cell components. Recently E. N. Harvey (*33*) has calculated the density gradients necessary to separate certain X and Y chromosomes in man and in some animals and has concluded that they might be separated in the vacuum-type ultracentrifuge similar to that in Fig. 1. The high resolving power ultracentrifuge of Fig. 6 also would seem to be well suited to this problem of the separation and collection of the chromosomes or other cell components.

The relative displacement of the various components of the biological cell in centrifugal fields has been studied by a number of different workers with most interesting and important results. No attempt can be

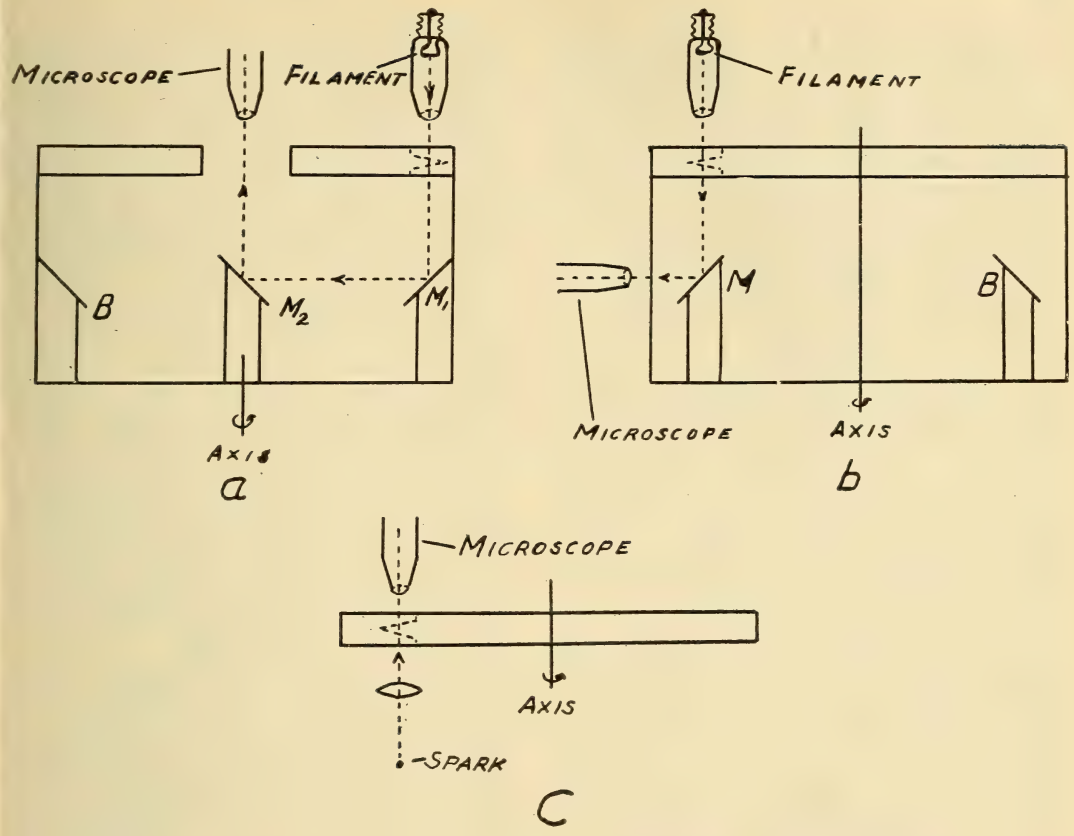


FIG. 9.—Schematic diagram of methods of viewing or photographing objects in a centrifuge by means of a microscope.

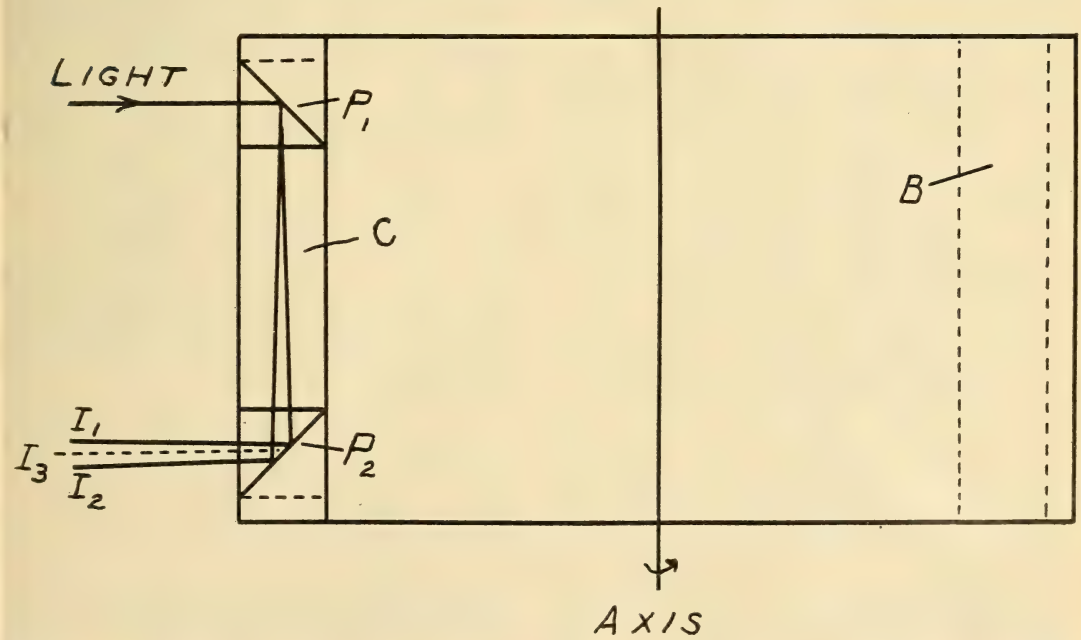


FIG. 10.—Schematic diagram of an optical method for viewing double refraction in an ultracentrifuge.

made here to describe the results of these experiments, but it might be noted that E. N. and E. B. Harvey (*34*) have found that practically all egg cells contain particles which separate into zones according to their densities. H. W. Beams (*35, 36*) and his collaborators find that when *Paramaecium, Euglena,* and other flagellates and various tissue cells are placed in high centrifugal fields, Nissl bodies (or nerve cells) plastids, chromosomes, and mitochondria are heavier, while the oil, vacuoles, Golgi apparatus, and resting nucleus are lighter than the fluid of the cell. In the nucleus the sap is lightest followed by chromatin and reticulum, nucleolus in order of increasing density. Some cells can be centrifuged for long times in centrifugal fields of several hundred thousand times gravity and still recover while others are killed.

In carrying out the above studies it is sometimes desirable to watch the separation taking place in the ultracentrifuge. E. N. Harvey (*34*) has used a scheme shown in Fig. 9, *a*, E. G. Pickels (*37*) used the scheme in Fig. 9, *b*, while Fig. 9, *c*, shows the older method. In Fig. 9, *a* and *b*, a magnification of about 100 times can be used while in 9, *c*, the possible magnification depends upon the shortness of the spark light source.

In some sedimentation problems it is desirable to find out if the molecules have a preferential orientation. This is especially true for the case of threadlike molecules where anomalous sedimentation is sometimes observed (*10, 16, 38, 39*). It is well known that molecules with anisotropic optical properties, when aligned, produce double refraction of a light beam. However, double refraction produced by the contents of a standard centrifuge cell, Fig. 1, is practically impossible to observe because of the much larger double refraction produced by the centrifugally induced strains in the cell windows. In order to overcome this difficulty of induced window strains, the scheme of Fig. 10 has been used successfully at Virginia. Two matched quartz-crystal double-image prisms of the Cotton type are used as windows of the cell C. They are cut so that one of their right-angle faces is parallel and the other perpendicular to the optic axis. If light falls upon P_1 it emerges into the cell C in two beams plane-polarized perpendicular to each other. If now no double refraction exists in the cell C the light emerges from P_2 in two beams I_1 and I_2. However, if double refraction exists in the cell C the light emerges from P_2 in three beams, I_1, I_2, and I_3. From the relative intensity of the central beams to each of the others, the amount of double refraction can be determined. The method is quite sensitive and not difficult to use. The cross section of P_1 and P_2 (shown in the plane of the paper) may be oriented, with respect to a plane passing through the axis and radius, to determine the sign of the double refraction. No double refraction has as yet been observed with several pure solvents such as water, CCl_4, CS_2, and nitrobenzine, showing that orientation in these pure liquids is not appreciable. However, a critical examination of the sedimenting threadlike molecules has not yet been made.

Sedimentation can be obtained in gases or vapors as well as in liquid solutions with the vacuum-type ultracentrifuge. Because of the rapid diffusion in gases, equilibrium between sedimentation and diffusion takes place very quickly. If p is the pressure and ρ the density of the gas or vapor at any radius r, then $dp = \rho\omega^2 r dr$ where ω is the angular speed. From the well-known equation of state of a gas or vapor

$$p = \frac{RT}{M}\rho + \frac{B}{M^2}\rho^2 + \frac{C}{M^3}\rho^3 + \qquad (11)$$

$$dp = \frac{RT}{M}d\rho + \frac{2B}{M^2}\rho d\rho + \frac{3C}{M^3}\rho^2 d\rho +$$

where M is the molecular weight of the gas, T is the absolute temperature, and B, C, etc., are known constants for each gas. Therefore

$$\tfrac{1}{2}\omega^2 r^2 = \frac{RT}{M}\log\frac{\rho_p}{\rho_c} + \frac{2B}{M^2}\left(\rho_p - \rho_c\right) + \frac{3C}{2M^3}\left(\rho_p^2 - \rho_c^2\right) \qquad (12)$$

where ρ_p is the density at the periphery and ρ_c is the density at the axis. Everything in equation (12) can be measured in a cen-

trifuging experiment except M so that the molecular weight of the gas can be obtained. In some gases, at ordinary temperature and at atmospheric pressure and below, and in many vapors at low pressure, all the terms on the right hand side of equation (12) become negligibly small in comparison to the first term; i.e., Boyle's law is obeyed. When this occurs,

$$\rho_p = \rho_c e^{\frac{M\omega^2 r^2}{2RT}},$$

and the density increases exponentially with radius. If the centrifuge contains a mixture of gases, the density of each gas independently of the others is given by equation (12). It will be observed that this approximate exponential relation between density and centrifuge radius is the same type of relation as that existing between the density and height in the atmosphere due to the gravitational field of the earth. As a consequence we can produce such an atmospheric gradient in the laboratory for study if desired. Recently, it has been found that, with some care, the molecular weight of a gas can be measured with a precision of the order of 0.1 per cent by the above centrifuging method. The experiment consists in spinning the gas in a short cylindrical rotor with a hollow shaft so that the density at the axis can be accurately measured, with the rotor at rest and at various speeds. From a series of these measurements the molecular weight of the gas is obtained. In the case of a radioactive gas the amount of radioactivity is proportional to the density of the gas. Consequently, this method may be used for the direct determination of the molecular weights of radioactive gases. For such experiments only extremely minute quantities of the radioactive gas should be required (much less than for the mass spectrometer), which of course is a considerable advantage since many of these gases are quite rare. Since the density gradient of any gas or vapor in a centrifuge depends upon its molecular weight in the exponent of e, the high speed centrifuge can be used for the separation of gases or the isotopes in gas or vapor. A considerable amount of work has been carried out on this latter problem (*16*), but no attempt can be made to discuss it here.

When substances are placed in a centrifuge two general types of phenomena may occur. The first type depends upon $\omega^2 r^2$ or the square of the peripheral velocity while the second type depends upon $\omega^2 r$ or the intensity of the centrifugal field. Examples of these two types are described by equation (3) and equation (7) respectively. As mentioned before the maximum stress produced in a homogeneous elastic rotor is proportional to $\omega^2 r^2$ or the square of the peripheral velocity. That is, similarly shaped rotors made of the same material but of different sizes will explode when their peripheral speeds are approximately equal. Therefore, in order to increase $\omega^2 r^2$ appreciably over that obtained with the vacuum type ultracentrifuges of Figs. 1 and 3 new materials with greater strength to density ratios must be developed. This follows from the fact that the only limiting factor to the speed of the vacuum-type ultracentrifuge is the mechanical strength of the centrifuge rotor. However, $\omega^2 r$ or the centrifugal field can be greatly increased by reducing the size of the rotor. A method (*40, 41, 42, 43*) for doing this is shown schematically in Fig. 11. The steel rotor R is suspended in

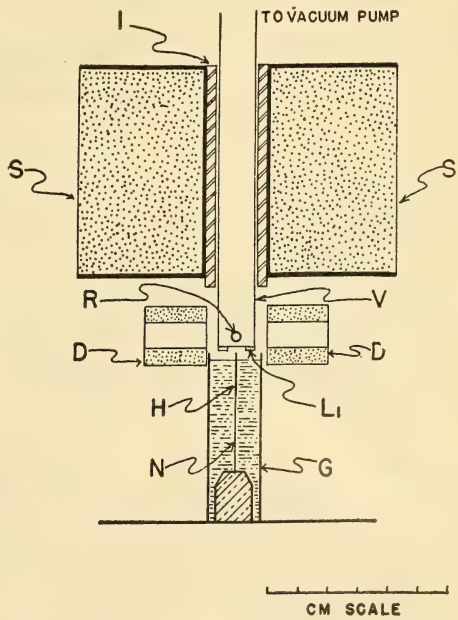


FIG. 11. Diagram of small-rotor apparatus.

the axial magnetic field of the solenoid *S* and is spun by a 2-phase rotating magnetic field in the two pairs of coils *D*. The vertical position of the steel (or other ferromagnetic) rotor is maintained by an automatic regulation of the current through the

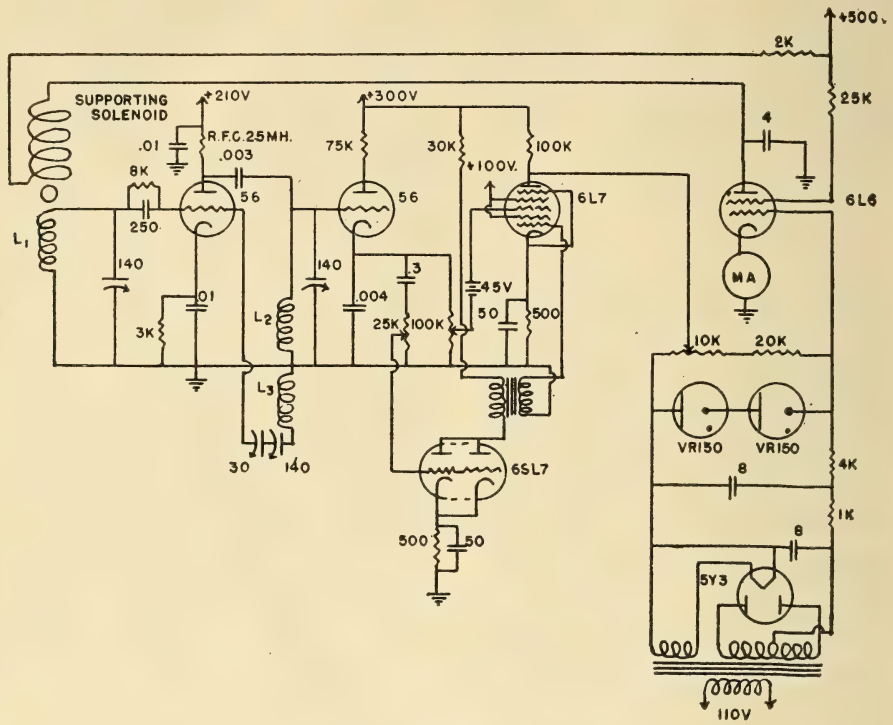


FIG. 12.—Suspension circuit.

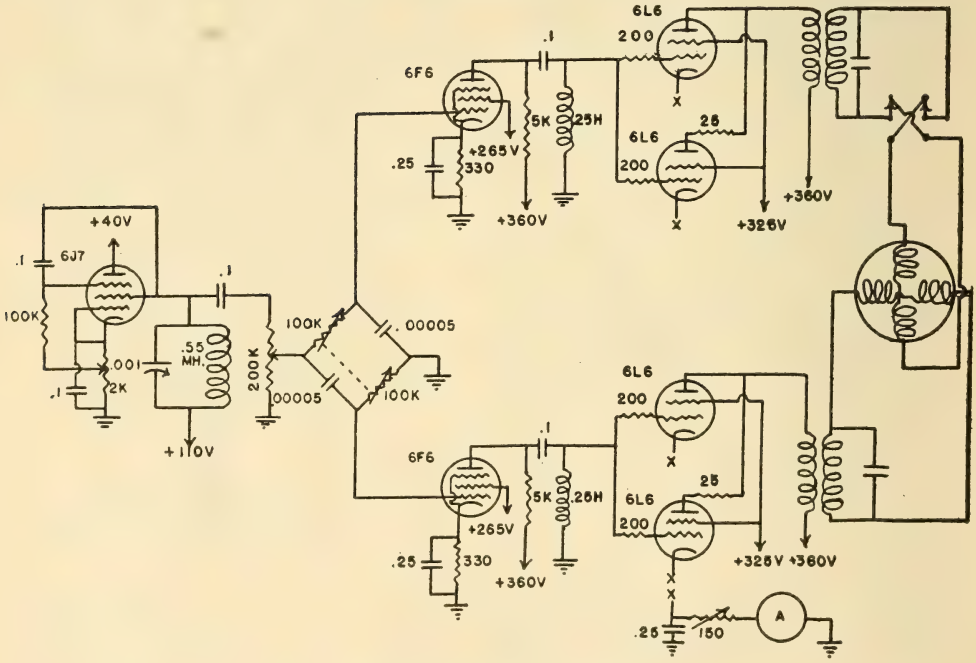


FIG. 13.—Driving circuit.

solenoid S while its horizontal position is maintained by the symmetrically diverging magnetic field of the solenoid. The small "pick up" coil L_1 is in the grid circuit of a tuned-grid tuned-plate radio-frequency oscillator, which regulates the current through S (Fig. 12). This circuit is so arranged that when the rotor R rises the current through S decreases. These current changes are such as to position accurately the rotor without observable hunting. It will be observed from Fig. 12 that this is accomplished by introducing a derivative or "anti-hunt" signal along with the signal from the pick-up coil L_1. An idea of the stability of the rotor can be obtained from the fact that no vertical motion could be observed with a 30-power microscope focused on the markings of the rotor. A small iron wire H mounted in a glass tube filled with a liquid assists in damping any horizontal motion of the rotor. The glass chamber V surrounding the rotor R was evacuated by the usual cold trap, diffusion pump, and fore pump combination. The pressures surrounding the rotor were measured by an ionization gauge. Fig. 13 shows a diagram of the driving circuit which produces the rotating magnetic field in the coils D. The output of the transition oscillator is passed through a volume control and then a phase-splitting bridge. Each of the phases is amplified and applied to the coils so that the current in the coils D are approximately 90° out of phase. The frequency was varied up to 750,000 cycles/sec, which was used for accelerating a 0.521-mm rotor. The rotor speed is measured by the arrangement schematically shown in Fig. 14. One-half of the rotor is polished and the other half darkened by dipping in dilute H_2SO_4, which had been in contact with metallic antimony. The dark layer is very thin and adheres to the rotor until the centrifugal field reaches the order of 4×10^8 gravity. Light from an incandescent lamp A is focused on the rotor R and the resulting scattered light focused on the electron multiplier photocell P. The variable output from the photocell, owing to the spin of the rotor, is amplified and fed to one pair of plates of a cathode ray oscilloscope. The frequency of the rotor is then compared with the sweep frequency applied to the other pair of plates of the oscilloscope. This sweep frequency is calibrated by a standard frequency oscillator (accurate from 0.1 to 0.01 per cent) up to 50,000 cycles/sec. Above this frequency multiples of the calibrated frequencies are used (*45*).

It is well known that, for rotors made of a given elastic material, the highest peripheral speed should be obtainable when the shape is such that the radial and tangential stresses are of constant value throughout the rotor. In practice small hardened steel rotors are difficult to grind to the shape required by the above conditions so hard-spherical steel rotors (from ball bearings) were used. Each spherical rotor had a small flat (about 1 mil) ground off of it in order to determine its axis of rotation. Table 1 gives some of the results obtained just before the rotors explode. It will be observed that the maximum peripheral speed for all of the rotors is roughly 10^5 cm/sec, which is in agreement with the theory. In the fifth column are tabulated the maximum stresses in the rotors calculated by the method of Chree (*44*), assuming the rotors are perfectly elastic. These stresses reach a maximum at the center of the rotor and fall off toward the surface. The calculated values may be somewhat larger than those actually existing because the steel is known to be plastic. This would give rise to plastic flow in small regions around the center and hence would relieve the stresses.

TABLE 1

Diameter rotor	Rotor speed	Peripheral speed	Centrifugal acceleration ×gravity	Maximum calculated stress
mm	*r.p.s.*	*cm/sec*		*lb./in.*^{2}
3.97	77,000	9.60×10^4	4.71×10^7	410,000
2.38	123,500	9.25×10^4	7.20×10^7	385,000
1.59	211,000	1.05×10^5	1.43×10^8	498,000
.795	386,000	9.65×10^4	2.40×10^8	420,000
.521	633,000	1.04×10^5	4.28×10^8	488,000

It will be observed that the magnetic field that supports the rotor is symmetrical with respect to the axis of rotation. As a result no eddy currents are produced in the rotor that tend to damp its rotation; i.e., there should be no electromagnetic drag. With a 1/16-inch or 1.59-mm rotor spinning

at 100,000 r.p.s., the driving current in the coils D was turned off and the rotor allowed to coast while the deceleration was measured. It was found that it required about 1 hour to lose 0.1 per cent of its speed. The air pressure surrounding the rotor during these experiments was approximately 2×10^{-6} mm of Hg. The drag on the rotor due to air friction can be calculated from the relation (*42*)

$$\log_e \frac{N}{N_o} = \frac{-5p}{rd}\left(\frac{M}{2\pi RT}\right)^{1/2}\left(t - t_o\right)$$

where N_o is the number of r.p.s. at the time t_o, N is the number of r.p.s. at time t, p is the pressure in bars, d is the density of the steel (7.8 gms/cm^5), T is the absolute temperature, M is the molecular weight of the gas, and r is the radius of the spherical rotor. Substituting into this equation, it is found that practically all the observed drag can be accounted for by air friction alone, although there may be a very small residual drag due to inhomogeneities. Clearly this spinning rotor arrangement should serve as an excellent absolute pressure manometer for measuring low gas pressures.

The very small observed drag on the rotor suggested that the rotor would continue to accelerate until it reached the driving frequency. That is, during the acceleration period the rotor would operate in a way similar to that of an armature of an induction motor, but as soon as it approached closely enough to the frequency of the rotating field in the driving coils D (Fig. 11) it would shift over and run as a synchronous motor. This would be expected from the fact that the rotor is steel and should become magnetized when the rotor speed and driving frequency become nearly equal. Experiment showed that the rotor actually reaches the speed of the driving frequency and then "locks into" this frequency. It is well known that the frequency of a piezoelectric crystal will remain extremely constant if it is cut properly and connected into the proper circuit and if its temperature is held constant. The driving oscillator in the circuit of Fig. 13 was replaced by such a piezoelectric crystal oscillator with a frequency of 100,000 cycles/sec. A 1.59 mm rotor surrounded by a gas pressure of 2×10^{-6} mm Hg or less was allowed to accelerate up to the frequency of the piezoelectric crystal and "lock in" with it. In order to determine when this "locking in" takes place a signal from the piezoelectric crystal driving circuit was applied to one pair of plates of a cathode-ray oscilloscope while the signal from the electron multiplier photoelectric cell (Fig. 14) was applied to the other pair of plates of the same oscilloscope. The two signals were made to give approximately the same deflection so that when the rotor speed reached exactly the driving frequency the Lissajous figure became a stationary circle on the screen. It is interesting to note that when the rotor speed first reaches the driving frequency, a slight hunting occurs. However, this hunting damps out and as far as can be determined, completely vanishes in a few minutes. This damping of the hunting is apparently electromagnetic. Therefore, the speed of these rotors can be made as constant as the frequency of a piezoelectric crystal circuit.

The temperature of the spinning rotor has not been measured directly but an upper limit for it can be obtained by measuring the temperature of the rotor at rest in the vacuum chamber with the full power applied to the driving coils D. This was ac-

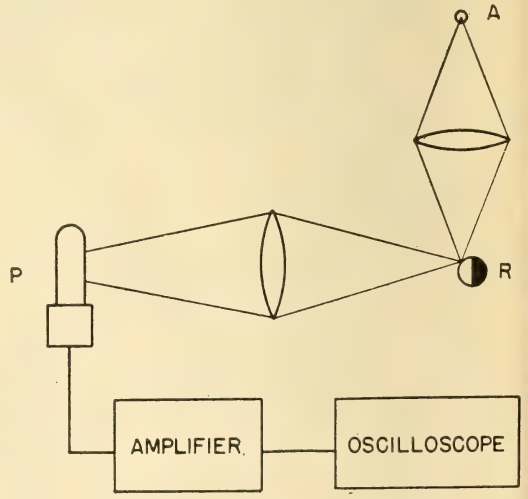


FIG. 14.—Schematic arrangement for measuring rotor speed.

complished by fastening a thermocouple made of fine wires to the rotor, then evacuating the vacuum chamber surrounding the rotor and applying the power to the coils *D*. The maximum increase in temperature was between 5° and 6°C. Therefore the rise in temperature of the spinning rotor is less than 6°C. Small mirrors have been ground on these magnetically suspended rotors without introducing appreciable added friction. Consequently rotating mirrors are available whose rotor speed not only is very high but extremely constant, and it should be possible to obtain greater precision for example in such determinations as the velocity of light. Obviously this technique of producing both very high centrifugal fields and very high and constant rotor speeds opens many new avenues for interesting investigations.

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ENTOMOLOGY.—*A new* Schematiza *on* Cordia *in Trinidad (Coleoptera: Chrysomelidae).*[1]

H. S. Barber, Bureau of Entomology and Plant Quarantine.

A third request for specific identification of a galerucine beetle destructive to *Cordia macrostachya* in Trinidad requires proposal of a new specific name. The two previous samples received in 1944 and 1945 were compared with old samples of *Schematiza lateralis* presented to the National Museum by Godman and Salvin from the "Biologia" collection and were found distinct as herein noted; but parallel samples sent for identification from Trinidad to England were reported under the name of that Central American species, which displays rather distinctive characters. This tropical genus may be as complex, and the species as difficult to distinguish, as is our closely related genus *Galerucella,* in which similar forms or species seem more easily recognized by their host associations than by any characters visible in preserved specimens. Such data for tropical forms however, are, rarely available.

The genonym *Schematiza* was proposed by Chevrolat, 1837 (Catalt. Coleopt. Coll. Dejean, 3d ed., p. 401; p. 377 of the "1833" edition), including one previously described species, *Lycus laevigatus* Fabricius, 1801, and *nomina nuda* for five other species. Its citation as a *nomen nudum* by Sherborn, 1930 (Index Animalium, p. 5789), and by Neave, 1930 (Nomenclator Zoologicus **4**: 130), seems misleading. Guérin, 1844 (Icon. Règne Animal, Ins., p. 303), adopted the name from the Dejean catalogue but stated his uncertainty as to generic relationship of the five species he named as new, with the species in the Dejean collection. Chevrolat, 1845 (*in* D'Orbigny, Dict. Hist. Nat. **6**: 5), cites *C. marginata* Fabricius as type of *Schematiza,* but as this name was not originally included and no such species seems traceable in recent catalogues, it must have been a *lapsus.* Blanchard, 1845 (Hist. Ins. **2**: 190), offers a description of *Schematiza* Chevrolat without mention of any species. Chevrolat, 1848 (*in* D'Orbigny, Dict. Hist. Nat. **11**: 413), again treats the genus with *Lycus laevigatus* Fabricius and the five *nomina nuda* as originally listed. The number of described species grew to 19 listed by Gemminger and Harold, 1876, in the Munich catalogue and 32 listed by Weise, 1924, in the Junk catalogue, the former ascribing the genus to Blanchard, 1845, and the latter to Guérin, 1844, with *lycoides* Guérin, 1844, cited as genotype. Under the Code, *Schematiza* Chevrolat is valid in Dejean, 1837, and *Lycus laevigatus* Fabricius, 1801, the only described species there available and automatically its genotype, is now designated type of the genus.

Schematiza laevigata (Fabricius)

Lycus laevigatus Fabricius, Syst. El. **2**: 117. 1801.
Homalisus laevigatus Schoenherr, Syn. Ins. **1** (pt. 3): 77. 1817.
Schematiza axillaris Dejean, Cat. Coleopt. Coll. Dejean, 3d ed.: 402. 1837.
?*Schematiza axillaris* Guérin, Icon. Règne. Animal, Insects: 304. 1844.

This species seems to be lost from recent catalogues. It was described as black with thoracic margin and a basal elytral line rusty, the elytra smooth, the body small, the antennae compressed and wholly black, and the habitat data as "in America meridionalis. D. Smidt. Mus. D. Lund." The name *laevigatus* Fabricius, 1801, is listed in *Homalisus* by Schoenherr, 1817, and by Sturm, 1826 (Catal. meiner Ins. Sammlung, p. 153), the latter changing its habitat to Brazil. I have failed to trace the name beyond 1837 where *axillaris* Dejean attained nomenclatorial status by its publication as a new name for *laevigatus* Fabricius, and 1844, where Guérin suggested that his "new species" *axillaris* from Cayenne might be conspecific with *laevigatus* F. as now again seems probable. A specimen from the Wickham collection labeled "Bartica, Demerara, R. J. Crew" agrees with the descriptions of both *laevigatus* and *axillaris.* Mequignon, 1934 (Bull. Soc. Ent. France **39**: 171–172), explains that Smidt resided in the Danish West Indian island of St. Thomas and assumes this to be the type locality of two problematic species of *Chelonarium,* but in similar problems involving types from Smidt the ports made en route to and from his objective must be considered. Delay in these ports might have per-

[1] Received March 28, 1947.

mitted him to collect there for the museums of Messrs. Lund and Sehestedt.

Schematiza lateralis Jacoby

Jacoby, 1887 (Biol. Centr.-Amer., Coleopt., 6 (pt. 1): 498), adopts *Schematiza* (Chevrolat) Blanchard, 1845, with comments on included forms so similar to *Galerucella* as to suggest assignment there. Among his eight new species *S. lateralis* is described (p. 499) from "Mexico, Oaxaca (Salle), and Panama, Volcán de Chiriquí, Bugaba (Champion)," mentioning many specimens but designating no type locality or holotype. Four of the specimens collected by Champion on the Volcán de Chiriquí were presented to the United States National Museum. One of these specimens does not agree with Jacoby's description and is obviously specifically distinct from the other three. Lest the Oaxaca cotype be also found specifically distinct, the type locality of *lateralis* is now designated as the Volcán de Chiriquí. In these three cotypes a rather strong costa, prominent enough above the submarginal sulcus to obscure the marginal costa in direct dorsal aspect, runs almost straight from humerus to apical fifth of elytra where it curves strongly inward ending near middle of apex. This costa, the pale submarginal elytral vitta, the shape of the pronotum, the black median pronotal vitta and the narrower, more parallel form are peculiarities of *lateralis* not found in the species from Trinidad which has been misidentified as *lateralis* but which may be known as follows:

Schematiza cordiae, n. sp.

Opaque, fuscous, depressed, elongate oval, sides arcuate, length 6–7.5 mm, width 3–3.6 mm.

Pronotum twice as wide as long, sides expanded and strongly arcuate, surface broadly impressed at lateral fourths and narrowly over occiput. Elytra smooth, evenly convex from within the prominent marginal costa to the elevated sutural costa, showing no vestige of submarginal costa characteristic of *lateralis;* sculpture and vestiture fine and dense. Antennae slightly thickened near middle, tapering apically, not flattened. Sexes extremely similar.

Described from 16 specimens labeled "on black sage, St. Augustine, Trinidad, B. W. I. May 2, 1944. A. M. Adamson, collector, 4070."

Host plant.—Cordia macrostachya.

Holotype male and 12 paratypes, U.S.N.M. no. 58362.

Three paratypes returned to F. J. Simmonds in Trinidad. A similar sample now referred to this species consists of 31 specimens labeled "on *Cordia cylindrostachya,* Caracas, D. F., Venezuela, Oct. 4, 1939, C. H. Ballou, No. 934." Eight specimens from St. Vincent seem to represent a very closely related species.

ENTOMOLOGY.—*New North American species and new assignments in the genus* Chionodes (*Lepidoptera: Gelechiidae*).[1]

J. F. GATES CLARKE, Bureau of Entomology and Plant Quarantine.

The purpose of this paper is to assign certain species of North American gelechiids, the generic position of which was not determined by Busck, and to describe some of a large number of hitherto unnamed species in this family that have been accumulating at the United States National Museum. In Busck's paper[2] he did not recognize some of Annette F. Braun's and E. Meyrick's species and therefore did not assign them to their proper genera. I have examined some of these and will assign them to the appropriate genera in this and subsequent papers.

Genus **Chionodes** Hübner

Chionodes nigrobarbata (Braun), n. comb.

Gelechia nigrobarbata Braun, Can. Ent. **57**:125. 1925.

Chionodes occlusa (Braun), n. comb.

Gelechia occlusa Braun, Can. Ent. **57**: 126. 1925.

Chionodes permacta (Braun), n. comb.

Gelechia permacta Braun, Can. Ent. **57**: 126. 1925.

Chionodes asema, n. sp.

Figs. 6–6c, 15

Labial palpus with second segment ocherous

[1] Received February 4, 1947.

[2] BUSCK, A., *Restriction of the genus* Gelechia (*Lepidoptera: Gelechiidae*), *with descriptions of new species.* Proc. U. S. Nat. Mus. **86**: 574. 1939.

white inwardly, blackish fuscous exteriorly and in the brush; third segment mixed blackish fuscous and ocherous-white; tip ocherous-white. Antenna blackish fuscous annulated with pale ocherous. Head and thorax pale yellowish brown, mixed with a few scattered black and fuscous scales; base of tegula blackish fuscous. Forewing ground color sordid white, so heavily overlaid with pale yellow-brown and blackish-fuscous markings as to be obscured except in some specimens in which the ground color is pronounced along costa; at basal fourth an outwardly oblique, blackish-fuscous fascia extends almost to dorsum at basal third; a spur of this fascia branches off and extends almost to middle of cell; from the end of cell to tornus is another outwardly oblique, blackish-fuscous fascia; from costa, at apical third a narrow, S-shaped, pale line extends completely across wing; preceding the pale line is a fuscous spot on costa; beyond this line is a blackish-fuscous shading; cilia pale yellowish brown. Hind wing light gray basally shading to blackish fuscous at apex; cilia fuscous, first and second legs ocherous white inwardly, banded with blackish fuscous outwardly. Abdomen fuscous above, buff beneath, shaded with fuscous.

Male genitalia.—Harpes asymmetrical. Right harpe slender and, with its terminal setae, nearly attaining apex of uncus; at base is a strong angulate process and near distal end is a small, sharp ventrolateral tooth; left harpe long, slender, curved, terminating in a sharp point. Gnathos strong, angulate. Aedeagus slightly more than twice as long as right harpe, the stalk half as long as the stout distal portion; from side, near terminal end, a strong sclerotized process divided at its outer end.

Female genitalia.—Ostium wide. Ductus bursae broad, sclerotized for nearly its entire length. Inception of ductus seminalis at posterior end of bursa copulatrix; in posterior part of bursa are numerous small scobinations; signum a subquadrate plate with several sharp teeth at the anterior and posterior ends.

Alar expanse, 12–16 mm.

Type.—U.S.N.M. no. 58234.

Type locality.—Putnam County, Ill.

Remarks.—Described from the ♂ type and five ♂ and two ♀ paratypes as follows: ♂ type, and 1 ♂ paratype, Putnam County, Ill. (29-VI and 15-VII-1941, Murray O. Glenn); 2 ♂ ♂, 2 ♀ ♀, Oak Station, Allegheny County, Pa. (29-VII-1911, 4-VII-1909, 5-VII-1908, Fred Marloff); 3 ♂ ♂, Pittsburgh, Pa. (2-30-VII-1906, Henry Engel).

Paratypes in the United States National Museum, the British Museum, and the Murray O. Glenn collection.

This species is strikingly similar to *C. negundella* (Heinrich), but can be distinguished from it by the large basal process and small terminal spur of the right harpe, and by the signum, which is twice as large in *asema* and lacks the toothed edge of the signum of *negundella.*

Chionodes iridescens, n. sp.
Figs. 1–1a, 12

Labial palpus with second segment ocherous-white shading to ocherous in the brush; the entire length of second segment overlaid with black scaling above; third segment black except base and a few scattered scales, which are pale ocherous. Antenna black, annulated with sordid whitish. Face buff. Head, thorax, and forewing black with a strong purple iridescence; at apical third of forewing is a conspicuous, but small, buff spot; cilia gray. Hind wing grayish fuscous, darker toward margins; cilia gray. Underside of fore and hind wings sooty. First and second legs black with a few scattered buff scales; tarsi annulated with buff; third leg black exteriorly, buff inwardly; tarsi buff and black. Abdomen shining fuscous above, iridescent black beneath.

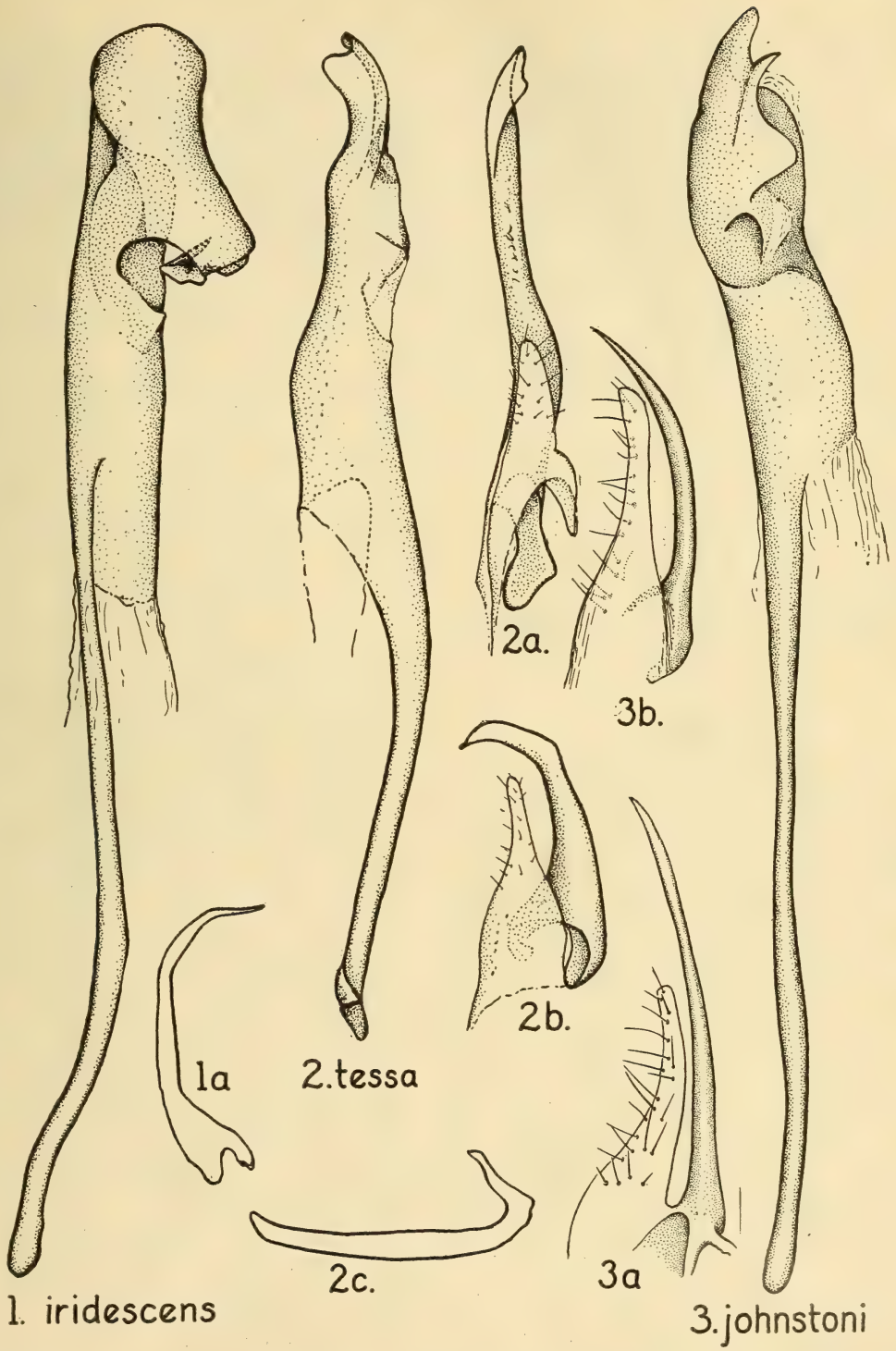
Male genitalia.—Harpes nearly symmetrical, about as long as the uncus, slender, curved. Gnathos long, slender, curved. Uncus large, hood-shaped, as broad as long. Aedeagus as long as the uncus, tegumen, and vinculum combined; slender stalk of aedeagus slightly longer than the enlarged distal part; from side, near end of aedeagus, a large winglike, bifid structure.

Female genitalia.—Ostium broad, opening into the broad, flattened sclerotized ductus bursae, which narrows as it joins the bursa copulatrix; inception of ductus seminalis from an evagination on the posterior left side of the bursa; signum a large irregular plate with two small thornlike processes from anterior and posterior ends.

Alar expanse, 16–17 mm.

Type.—U.S.N.M. no. 58235.

Type locality.—American Lake, Pierce County, Wash.



FIGS. 1–1a.—*Chionodes iridescens*, n. sp.: 1, Lateral view of aedeagus; 1*a*, left harpe, lateral aspect.
FIGS. 2–2c.—*Chionodes tessa*, n. sp.: 2, Lateral view of aedeagus; 2*a*, left harpe; 2*b*, right harpe; 2*c*, gnathos.
FIGS. 3–3b.—*Chionodes johnstoni*, n. sp.: 3, Lateral view of aedeagus; 3*a*, left harpe; 3*b*, right harpe.

Food plant.—*Arctostaphylos uva ursi* (L.).

Remarks.—Described from the ♂ type and three ♀ paratypes, all from the same locality, reared from larvae collected by the author. Paratypes in the United States National Museum and the British Museum.

Mature larva.—Length 9–13 mm. Head, thoracic shield, and anal plate shining black; shield edged anteriorly by luteous. Second and third thoracic, and abdominal segments light red brown mottled with light yellowish brown; there are five indistinct pale longitudinal stripes, the lateral broader than the dorsal and subdorsal stripes; tubercles black, edged with whitish; setae yellowish. Thoracic legs shining black.

The larvae were collected May 6, 1946. They were found tying the terminal leaves and forming a web about 1 inch below the tip. Pupation began May 12, and the first adult, a female, emerged June 3, 1946. The last moth of the series emerged on June 8.

Pupation may occur in the terminal leaves or in dead leaves and refuse at the base of the plant.

Chionodes johnstoni, n. sp.
Figs. 3–3b, 11

Labial palpus with second segment yellowish white heavily overlaid with blackish fuscous; apex narrowly banded yellowish white; third segment blackish fuscous except tip, which is white. Antenna blackish fuscous except tip of basal segment, which is yellowish white. Head, thorax, and forewing fuscous; face yellowish white; on the forewing are four small blackish-fuscous spots preceded and followed by pale-yellow scales; two of the spots are on vein 1b and two in the cell; on base of costa is a small blackish-fuscous shade mixed with pale-yellow scales; on costa at apical fourth a prominent pale-yellow spot extends across the wing forming an ill-defined fascia; along termen are two or three small pale-yellow spots; cilia yellowish fuscous speckled with fuscous. Hind wing grayish fuscous, darker at margins; cilia yellowish fuscous. Legs yellowish white overlaid and banded with fuscous. Abdomen fuscous.

Male genitalia.—Harpes asymmetrical. Right harpe slightly curved, sharply pointed, exceeding tegumen; basal process slightly more than two-thirds the length of harpe; left harpe about one-third longer than right harpe, slightly curved, bluntly pointed. Gnathos a strong, curved hook. Aedeagus slightly longer than remainder of genitalia, the slender stalk constituting about three-fifths of its length; at distal end is a broad 3-pointed process.

Female genitalia.—Ostium funnel-shaped, lightly sclerotized. Ductus bursae very short, membranous. Signum subtriangular with dentate edge anteriorly; inception of ductus seminalis at posterior edge of bursa copulatrix.

Alar expanse, 11–16 mm.

Type.—U.S.N.M. no. 58236.

Type locality.—Petaluma, Sonoma County, Calif.

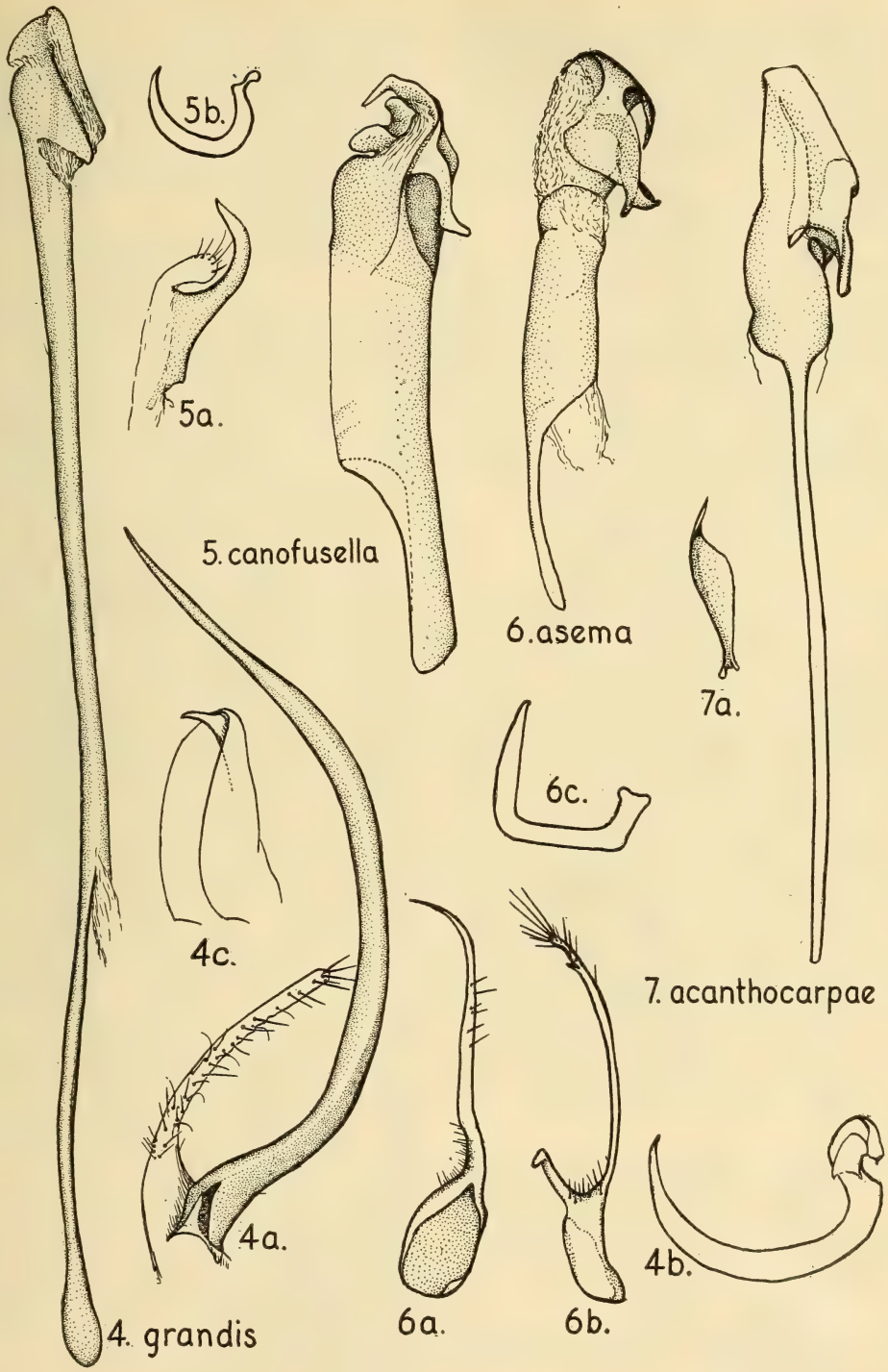
Remarks.—Described from the ♂ type, six ♂ and five ♀ paratypes all from the type locality, collected by E. C. Johnston on June ann July dates (type, 10-VII-35).

Paratypes in the United States National Museum, the British Museum, the Los Angeles Museum, and the E. C. Johnston collection.

Chionodes tessa, n. sp.
Figs. 2–2c, 13

Labial palpus white; second segment partly overlaid with black scales exteriorly and with a few black scales near tip interiorly; third segment strongly overlaid with black but tip always white. Antenna annulated sordid white and black. Head creamy white. Thorax blackish fuscous to black. Forewing white, more or less overlaid and marked with blackish fuscous to black; from costa at basal fourth an outwardly oblique white fascia extends to dorsum, continues along dorsum to join an irregular white area, the latter originating broadly on costa at middle; at apical third an irregular white fascia extends to tornus; from apex, along termen are two or three white spots; in the cell there is one small black spot; cilia light fuscous irrorate with blackish fuscous. Hind wing grayish fuscous; cilia light fuscous; hair pencil absent from underside. Legs creamy white broadly banded with blackish fuscous. Abdomen dark fuscous lightly marked with creamy white beneath.

Male genitalia.—Asymmetrical. Left harpe very long, slender, compressed distally, extending to middle of uncus; right harpe two-fifths the length of the left harpe, sharply curved ventrad. Gnathos nearly as long as uncus, sharply curved basally then nearly straight. Aedeagus as long as uncus and tegumen combined; proximal end bifid; distal end and a lateral extension, spoon-shaped.



FIGS. 4–4c.—*Chionodes grandis*, n. sp.: 4, Lateral view of aedeagus; 4*a*, right harpe; 4*b*, gnathos; 4*c*, ventrolateral aspect of uncus, in outline, to show caudal hook.

FIGS. 5–5b.—*Chionodes canofusella*, n. sp.: 5, Lateral view of aedeagus; 5*a*, left harpe; 5*b*, gnathos.

FIGS. 6–6c.—*Chionodes asema*, n. sp.: 6, Lateral view of aedeagus; 6*a*, left harpe; 6*b*, right harpe; 6*c*, gnathos.

FIGS. 7–7a.—*Chionodes acanthocarpae*, n. sp.: 7, Lateral view of aedeagus; 7*a*, left harpe.

Female genitalia.—Ostium broad. Ductus bursae not distinguishable from posterior end of bursa copulatrix. Ductus seminalis from posterior end of bursa copulatrix; signum a moderately sclerotized, irregular plate with a short, spatulate process, directed dorsad, from the posterior edge.

Alar expanse, 12–18 mm.

Type.—U.S.N.M. no. 58237.

Type locality.—Petaluma, Sonoma County, Calif.

Remarks.—Described from the ♂ type, five ♂ and seven ♀ paratypes from the type locality. All were collected by E. C. Johnston (5-V to 1-VII-1937–1938).

Paratypes in the United States National Museum, the British Museum, the Los Angeles Museum, and Mr. Johnston's collection.

Chionodes acanthocarpae, n. sp.
Figs. 7–7a

Labial palpus cream colored except for a fuscous spot at base of second segment exteriorly and a few scattered scales of the same color on the third segment. Antenna blackish fuscous. Head ocherous shading to cream on face. Thorax, except tegula and dorsal two-thirds of forewing, light brownish ocherous; tegula and costal third of forewing blackish fuscous; at apical fourth of wing a buff outwardly oblique fascia extends to middle, then is inwardly oblique to dorsal edge; at basal third and at middle the dark costal shade extends as a convex extension about one-half the distance to dorsal edge; at middle of wing is a conspicuous black spot followed at apical third by another similar spot; cilia light yellowish fuscous. Hind wing gray; cilia yellowish fuscous; hair pencil on underside absent. Legs ocherous-white suffused and banded with fuscous.

Male genitalia.—Symmetrical. Harpe blade-like, dorsal edge convex. Uncus slender, sickle-shaped. Aedeagus as long as main body of genitalia; distal third enlarged, stalk slender.

Alar expanse, 18–19 mm.

Type.—U.S.N.M. no. 58238.

Type locality.—Eagle Pass, Tex.

Food plant.—*Atriplex acanthocarpa* (Torr.) Wats.

Remarks.—Described from the ♂ type (18-V-1938, L. F. Hitchcock) and one ♂ paratype from San Diego, Calif. (12-IX-1919, Karl R. Coolidge).

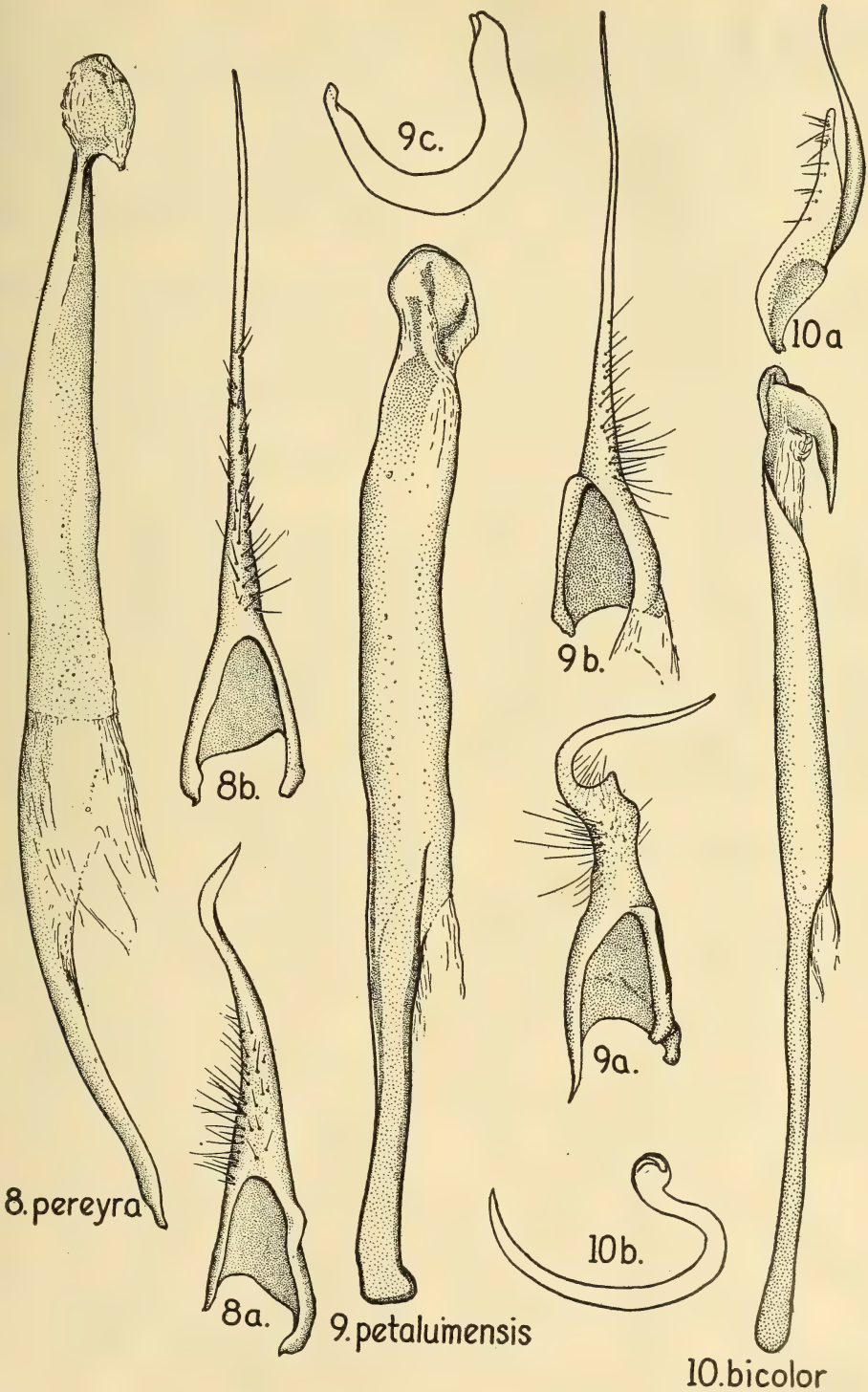
This species is closely related to *C. coticola* (Busck) and resembles it in pattern and genitalia. The line of demarcation between the dark and light areas of the forewing is straighter in *coticola* than in *acanthocarpae*, the harpe of the former is nearly twice as long as that of the latter, and the left harpe lacks the broad median expansion.

Chionodes canofusella, n. sp.
Figs. 5–5b, 16

Labial palpus with second segment white except basal third, which is blackish fuscous exteriorly; third segment pale ocherous at base, a blackish fuscous band interiorly and apical half entirely blackish fuscous. Antenna blackish fuscous. Head and thorax ocherous white overlaid with ocherous in some specimens; tegula blackish fuscous, apex tipped with brown; forewing blackish fuscous the whole length of wing in costal area, from about two-thirds the width of the wing at base obliquely, to approximately one-third the width of the wing at apex; remainder of wing ocherous white overlaid in apical half with ocherous and with a narrow, irregular, longitudinal brown line between the light dorsal portion and dark costal portion of the wing; around termen to and including tornus is a row of small, blackish-fuscous spots; at apical third on costa, a narrow, brown, transverse dash extends to the light area of the wing; cilia ocherous to light brown irrorate with blackish fuscous. Hind wing shining gray basally shading to dark fuscous at apex; cilia fuscous, lighter at anal angle; on the upper surface, in the male, from base of cubitus is a short yellowish fuscous pecten and from base of anal vein a strong hair pencil, yellowish fuscous at base shading to dark fuscous at its outer end. Legs creamy white overlaid and banded with blackish fuscous. Abdomen fuscous with creamy white beneath; anal tuft white.

Male genitalia.—Symmetrical. Dorsal lobe of harpe scarcely larger than the uncus; ventral lobe about half as long as the dorsal lobe, weak, fleshy. Aedeagus slightly longer than tegumen with the slender stalk constituting about one-third its length; from left side, near distal end, is a slender, reverse S-shaped process and from apex a short spur, curved cephalad. Uncus a strongly curved hook.

Female genitalia.—Ostium broad, funnel-shaped, narrowing to the short, membranous



FIGS. 8–8b.—*Chionodes pereyra*, n. sp.: 8, Lateral view of aedeagus; 8*a*, left harpe; 8*b*, right harpe.
FIGS. 9–9c.—*Chionodes petalumensis*, n. sp.: 9, Lateral view of aedeagus; 9*a*, left harpe; 9*b*, right harpe; 9*c*, gnathos.
FIGS. 10–10b.—*Chionodes bicolor*, n. sp.: 10, Lateral view of aedeagus; 10*a*, right harpe; 10*b*, gnathos.

ductus bursae; inception of ductus seminalis from posteroventral surface of bursa copulatrix. Bursa copulatrix without signum; in posterior portion partly sclerotized and studded with closely set, small, spinous processes.

Alar expanse, 14–16 mm.

Type.—U.S.N.M. no. 58239.

Type locality—Encantada, Brooks County, Tex.

Food plant.—Abutilon pedunculare HBK.

Remarks.—Described from the ♂ type, two ♂, and three ♀ paratypes from the type locality. All specimens bear the date November 28, 1940, and were collected by Hunt and McGarr. The type material was received through the Bureau of Entomology and Plant Quarantine. Paratypes in the United States National Museum and the British Museum.

This species resembles closely *C. hibiscella* (Busck) and, like *hibiscella*, feeds on a malvaceous plant. The two can be distinguished as follows: Males of *canofusella* have a hair pencil from the hind wing and a dark terminal half of the third segment of the palpus; both are lacking in *hibiscella*. In genitalia the differences are striking; the aedeagus of *hibiscella* has a large, recurved apical process with serrate edge and the female possesses a signum. Both of these features are absent in *canofusella*.

Chionodes bicolor, n. sp.

Figs. 10–10b

Labial palpus ocherous-white; second segment heavily overlaid exteriorly with fuscous; third segment dusted with fuscous; apex ocherous-white. Antenna fuscous with narrow, indistinct lighter annulations. Head, thorax, and the area of the fold to dorsal margin, from base to tornus, fawn color; anterior edge of thorax, base of tegula, and remainder of forewing (except as indicated below) dark purplish fuscous; from cell to costa, in basal half of wing an elongate, sometimes ill-defined blotch of fawn; at apical third a minute light spot; cilia yellowish fuscous mixed with dark purplish fuscous. Hind wing grayish fuscous, somewhat darker at apex; cilia yellowish fuscous; hair pencil from underside of costa in male, absent. Legs ocherous-white overlaid and annulated with fuscous. Abdomen fuscous except dorsal surface of first three segments, which is sordid yellow.

Male genitalia.—Symmetrical. Dorsal arm of harpe slender, sharply pointed, four-fifths the length of tegumen. Aedeagus as long as main portion of genitalia; slender stalk not quite as long as the thickened distal end; from apex, on right side is a long, sclerotized, pointed process directed basad. Gnathos very large, somewhat longer than harpe, sickle-shaped.

Alar expanse, 16–17 mm.

Type.—U.S.N.M. no. 58240.

Type locality.—Petaluma, Sonoma County, Calif.

Remarks.—Described from the ♂ type and three ♂ paratypes from the type locality. All were collected (5-9-IX-1936) by E. C. Johnston. Paratypes in the United States National Museum and Mr. Johnston's collection.

I have not seen a female of this species.

Chionodes petalumensis, n. sp.

Figs. 9–9c, 17

Labial palpus sordid whitish; brush of second segment suffused and irrorate with fuscous; exteriorly a broad, but poorly defined, subapical dark fuscous band; third segment strongly overlaid with dark fuscous. Antenna dark fuscous with light annulations. Head, thorax, and ground color of forewing lutescent variously marked with blackish fuscous and black; base of tegula and extreme base of costa black; on costa three dark spots, the one at basal fourth the largest of the three, black; on fold an elongate blackish-fuscous spot at basal third; beyond this, in cell, an outwardly oblique, short, black dash and at the end of cell a similarly colored spot; between the two an oblique, tear-shaped, whitish dash; beyond the outer discal spot and contiguous with it the wing is blackish fuscous bisected by a transverse line of the ground color at about apical fourth; around apex and termen is a series of small blackish fuscous spots; along costa, in the cell and around termen a few scattered white scales; along fold and in cell a few ocherous irrorations; cilia lutescent irrorate with blackish fuscous. Hind wing gray basally, shading to dark fuscous at apex; cilia fuscous; from a narrow, longitudinal, oblique pocket in the cell, on the underside in the male, a strong whitish hair pencil. Legs sordid whitish overlaid and annulated with dark fuscous. Abdomen sordid whitish suffused and irrorate with fuscous.

Male genitalia.—Asymmetrical. Left harpe broad with the ventrodistal corner produced into a long, slender process sharply curved dorsad; right harpe as long as tegumen, stout

basally, and produced into a long attenuated process. Aedeagus as long as main body of genitalia; stalk comprising basal two-fifths; near distal end a pronounced constriction forming a knoblike apex. Gnathos a thick, strong hook.

Female genitalia.—Ventral plate of ostium produced caudad into a spatulate process. Ductus bursae membranous for most of its length, broadened and sclerotized posteriorly; inception of ductus seminalis near posterior end of membranous part of ductus bursae. Signum a small sclerotized plate with two transverse ridges.

Alar expanse, 17–19 mm.

Type.—U.S.N.M. no. 58241.

Type locality.—Petaluma, Sonoma County, Calif.

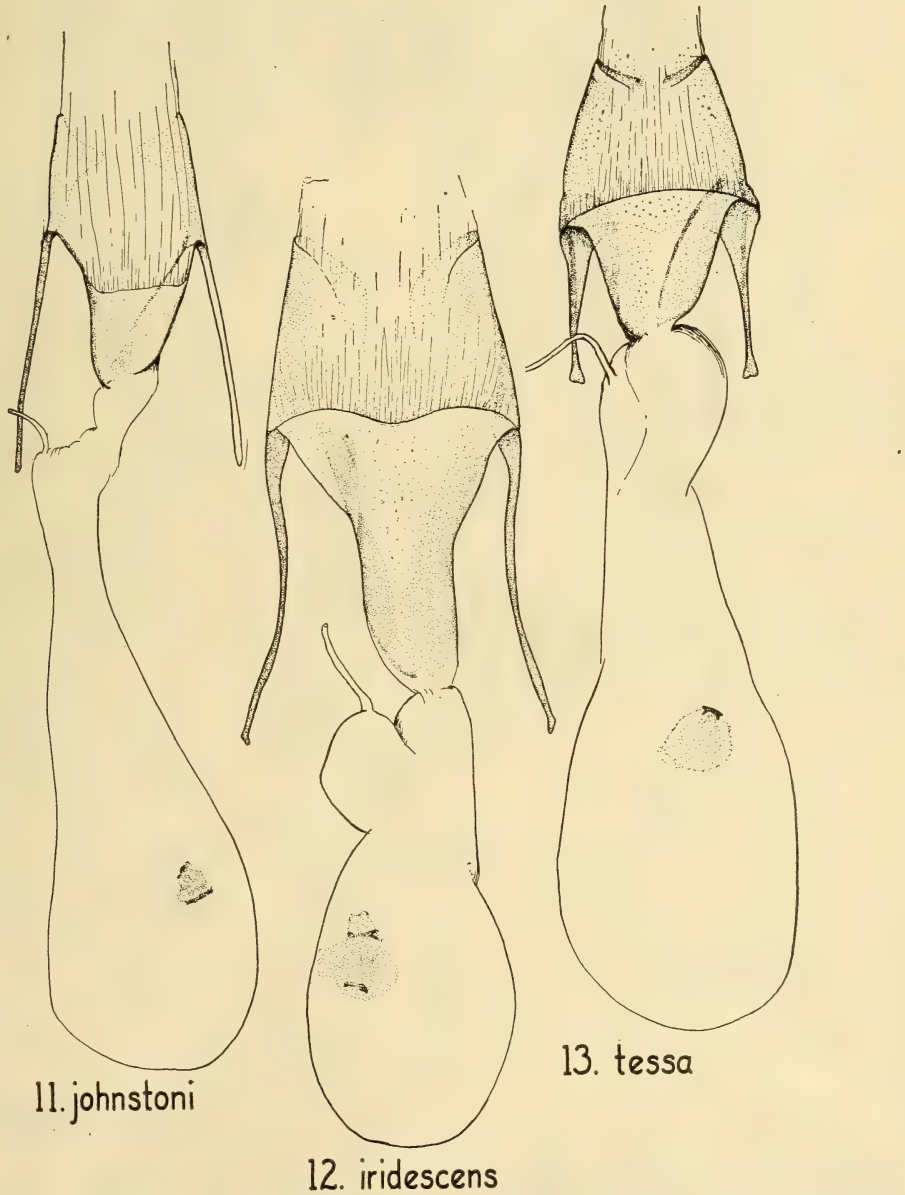


FIG. 11.—*Chionodes johnstoni*, n. sp.: Female genitalia, ventral aspect.
FIG. 12.—*Chionodes iridescens*, n. sp.: Female genitalia, ventral aspect.
FIG. 13.—*Chionodes tessa*, n. sp.: Female genitalia, ventral aspect.

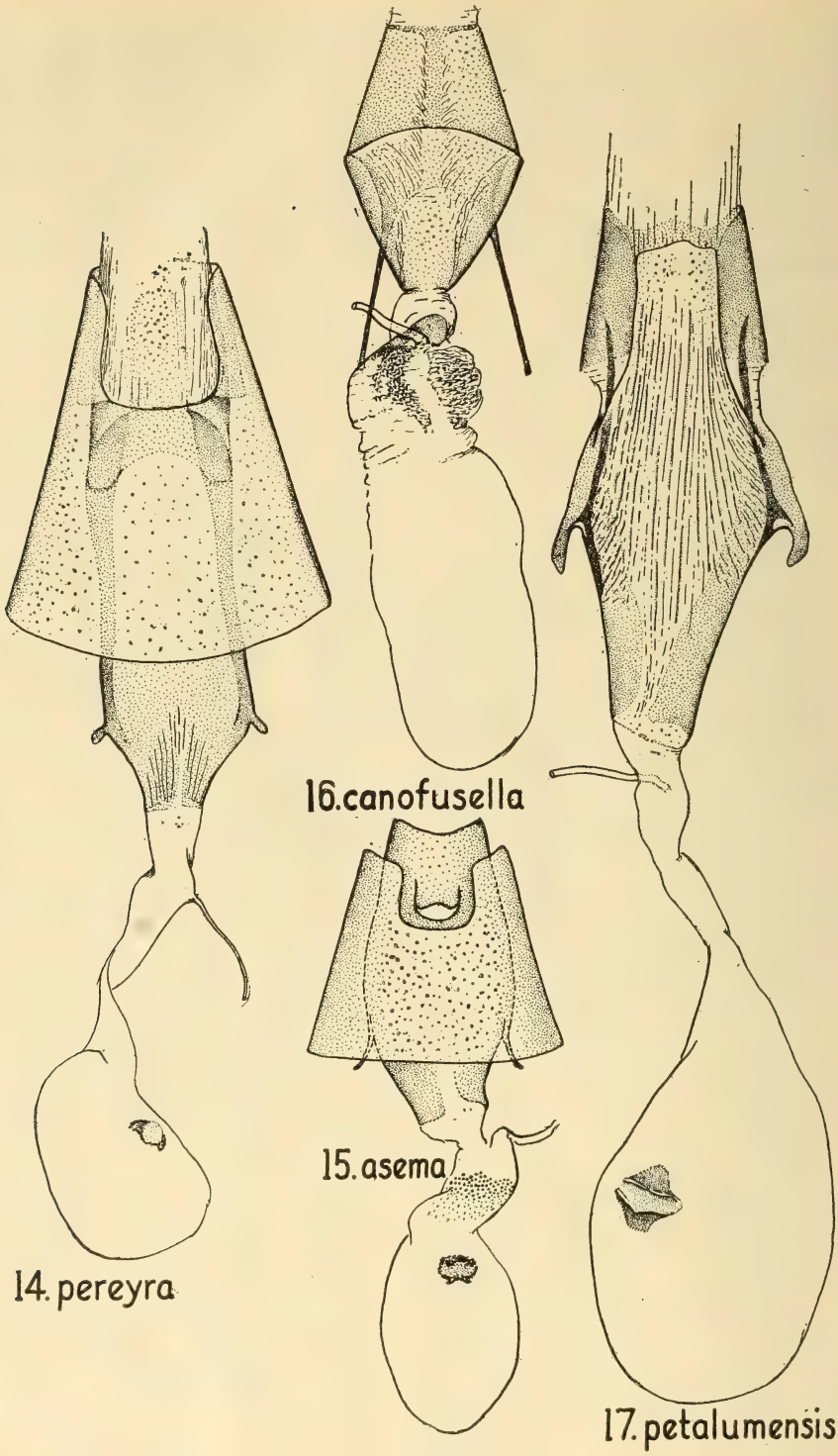


FIG. 14.—*Chionodes pereyra*, n. sp.: Female genitalia, ventral aspect, showing deeply excavated posteroventral edge of last abdominal segment.

FIG. 15.—*Chionodes asema*, n. sp.: Female genitalia, ventral aspect, showing deeply excavated posteroventral edge of last abdominal segment.

FIG. 16.—*Chionodes canofusella*, n. sp.: Female genitalia, ventral aspect.

FIG. 17.—*Chionodes petalumensis*, n. sp.: Female genitalia, ventral aspect.

Remarks.—Described from the ♂ type, eight ♂ and two ♀ paratypes as follows: Petaluma, 6 ♂ ♂, ♀ (29-VIII-1939, E. C. Johnston); Victoria, British Columbia, ♂, 2 ♀ ♀ (2-IV-21, E. H. Blackmore; 20-VII-21, 15-VII-22, W. R. Carter). Paratypes in the United States National Museum, the British Museum, and in Mr. Johnston's collection.

This species might be confused with *C. bicostomaculella* (Chambers) but is at once distinguishable from that species by the whitish dash in the cell. The asymmetrical male genitalia and the spatulate process in the female of *petalumensis* are further distinguishing characters.

Chionodes pereyra, n. sp.
Figs. 8–8b, 14

Labial palpus pale luteous suffused with light brown in the brush; second segment irrorate with blackish fuscous exteriorly; third segment almost wholly overlaid with blackish fuscous, but the apex always of the ground color. Head ocherous-white to sordid white, the scales brown to fuscous-tipped. Antenna blackish fuscous with light-brown annulations. Ground color of thorax and forewing luteous; most of the scales are tipped with light brown presenting the appearance, with the exception of the contrasting dark markings, of a light-brown wing; on costa at basal third is a conspicuous, moderately large, blackish-fuscous spot; on fold, slightly before middle, and in the center of the cell are elongate blackish-fuscous spots; at the end of cell is a spot of the same color; apical third of wing fuscous bisected by a pale transverse fascia at apical fourth, which is outwardly angulate to vein 6, then inwardly angulate to tornus; in some specimens is considerable fuscous shading dorsally, largely obscuring the lighter ground color; cilia light yellowish fuscous mixed with fuscous. Hind wing pale gray basally shading to dark fuscous apically and with a golden sheen; cilia fuscous, those around apex and outer margin narrowly white-tipped; hair pencil from hind wing of male absent. Legs ocherous-white suffused and banded with fuscous. Abdomen light fuscous above, the posterior edges of the segments narrowly bordered with ocherous-white to sordid white; underside ocherous-white suffused with fuscous posteriorly.

Male genitalia.—Asymmetrical. Left harpe broad basally tapering to a sharply pointed curved tip; right harpe slender, slightly longer than tegumen and produced into a fine fleshy point. Aedeagus nearly twice as long as tegumen, slender, the stalk comprising about basal third. Distal end constricted just before apex, the latter dilated. Gnathos a moderately weak hook.

Female genitalia.—Ostium broad, opening at the edge of the deep median excavation on the posterior edge of the last abdominal segment. Ductus bursae broad and flattened in the posterior half and sclerotized, inception of ductus seminalis near the posterior end of the membranous portion of the ductus bursae. Bursa copulatrix small; signum a small round plate with serrate processes from the anterior and posterior sides.

Alar expanse, 16–18 mm.

Type.—U.S.N.M. no. 58243.

Type locality.—Vero Beach, Fla.

Remarks.—Described from the ♂ type, one ♂ and seven ♀ paratypes all from the type locality. All were collected by John R. Malloch and bear April and May dates, 1941. Paratypes in the United States National Museum and the British Museum.

In pattern this species resembles *petalumensis* and is closely related to it as will be seen by a comparison of the genitalia. The male of *pereyra* lacks the sharply curved process of the harpe found in *petalumensis*, and the female of the latter species lacks the deeply excavated posterior edge of the terminal segment of *pereyra.*

Chionodes grandis, n. sp.
Figs. 4–4c

Labial palpus pale brownish gray, suffused, and irrorate with light fuscous. Antenna fuscous with indistinct, narrow, pale annulations. Head fuscous. Thorax and forewing dark purplish fuscous; on fold, at basal fourth, in the center of the cell and at the end of cell, ill-defined blackish-fuscous spots; at apical third on costa a small, indistinct, pale spot; cilia yellowish fuscous irrorate with blackish fuscous. Hind wing shining grayish fuscous; cilia yellowish fuscous basally, darker distally; hair pencil absent on underside of male. Legs shining fuscous; at bases of spurs and at ends of tarsal segments, small patches of ocherous-white. Abdomen shining fuscous with viola-

ceous cast; first three segments, dorsally, sordid yellow.

Male genitalia.—Symmetrical. Dorsal arm of harpe as long as tegumen and uncus combined, curved, slender, sharply pointed; ventral arm about one-third the length of the dorsal arm, filamentous. Aedeagus slender, about twice as long as dorsal arm of harpe; the slender stalk constituting about one-third the total length; apex enlarged and with two moderately sclerotized elongate plates directed away from apex. Gnathos a moderate sized hook.

Alar expanse, 25–28 mm.

Type.—U.S.N.M. no. 58242.

Type locality.—Silverton, Colo.

Remarks.—Described from the ♂ type and one ♂ paratype, both in the United States National Museum. The specimens were collected in July.

This is the largest species of the genus so far described. It resembles *C. permacta* (Braun) in wing shape and general appearance, but can be distinguished from that species by its larger size and the short, median, hooklike process of the uncus, which is about one-third the length of the median process of *permacta*.

ORNITHOLOGY.—*The races of the minivet* Pericrocotus peregrinus (*Linnaeus*) *in southeastern Asia.*[1]

H. G. Deignan, U. S. National Museum.

The extraordinary contradictions of Stuart Baker's successive treatments of this unfortunate minivet have been reviewed by Whistler and Kinnear (Journ. Bombay Nat. Hist. Soc. **36**: 343. 1933), who have at the same place set forth a sensible arrangement of the Indian races. It is now necessary that a similar revision be made of the forms occurring farther east.

Baker described *vividus* (see below) on characters of the male only, and gave its range as "Assam, Eastern Bengal, Manipur, Burma, Andamans, Siam, Cochin China." A series of 77 adults, chiefly from Siam, lying before me indicate that several distinct races, some of them with characters most evident in the females, have been hitherto embraced under this name. Owing to my complete lack of material from eastern Bengal, Assam, and most parts of Burma, a thorough study of "*vividus*" can not yet be presented; since, however, the type locality for the name lies on the frontiers of Siam, Siamese specimens are the ones of critical importance, and these are available in some abundance.

For the loan of their series of these birds, my thanks are due the authorities of the American Museum of Natural History and of the Academy of Natural Sciences of Philadelphia.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received March 20, 1947.

I now recognize the following southeastern Asiatic races:

1. Pericrocotus peregrinus thai, n. subsp.

Type.—Adult female, U.S.N.M. no. 336383, collected at Amphoe Chom Thong = Ban Luang (lat. 18°25′ N., long. 98°40′ E.), Chiang Mai Province, northwestern Siam, on February 9, 1937, by H. G. Deignan (original number 2315).

Diagnosis.—The adult female differs from those of *peregrinus* and *vividus* (in the restricted sense of this paper) by having the flanks and abdomen strongly washed with rich yellow or orange, rather than lightly washed with a less vivid yellow.

Baker's original description of "*vividus*" covers the characters of the adult male of *thai*. This reads: "Darker above than typical *peregrinus*; the throat generally rather blacker; the crimson [= flame-orange] breast brighter and extending lower on to the flanks and often on to the abdomen, remainder of the lower parts bright yellow with no, or practically no, white on the abdomen. Red on tail distinctly darker and more crimson [= orange]."

Range.—Burma (Thayetmyo District); Southern Shan States; Siam (north and east, south along the Mae Khong to the province of Ubon Ratcha Thani).

2. Pericrocotus peregrinus vividus Stuart Baker

Perecrocotus [*sic*] *peregrinus vividus* Stuart Baker, Bull. Brit. Orn. Club **40**: 114. Apr. 30, 1920

("Attaran River," Amherst District, Tenasserim Division, Burma; type locality here restricted to Pabyouk, "a village near a group of isolated limestone rocks on the right bank of the Attaran R. about 22 miles in a direct line S.E. of Moulmein," *fide* Hume and Davison, Stray Feathers **6**: 523. 1878).

Diagnosis.—The adult male is as described by Baker (see under *P. p. thai*), but in long series has the underparts perhaps a little less vivid, with a slight reduction of red and an increase of yellow, to approximate the race described next below.

The adult female differs from that of *thai* by having the flanks (and sometimes the abdomen) lightly washed with yellow.

In either sex the bill is slightly longer and heavier than that of *thai*, thus again showing approach to the following form.

Range.—Burma (Amherst District); Siam (southwest, reaching east to Bangkok).

Remarks.—The type locality for this race could scarcely have been more unwisely chosen! A line drawn from Moulmein in Tenasserim to Ban Rahaeng in western Siam represents the normal boundary between races of birds that vary between northwestern and southwestern Siam. The locality "Attaran River," as used by Davison, collector of the type specimen, means "between the old town of Attaran, distant about 34 miles S.E. of Moulmein and this latter" (*fide* Hume and Davison, *loc. cit. supra*, p. 522). The type thus came from some point on or just south of the dividing line and might well belong to a population exactly intermediate between *thai* and *vividus* as here understood. Inasmuch as a few poor specimens from Ban Rahaeng seem to belong to the more southern race, it is probable that those of Moulmein will also, but to improve the chances of the name *vividus*'s being properly employed for the population of southwestern Siam, I have now restricted the type locality to the most southern point on the Attaran River permissible by Hume and Davison's list of proveniences of the species (*loc. cit.*, p. 212). The type itself, as a male, is certain to be subspecifically unidentifiable, unless it possesses an exceptionally large bill, and the final disposition of the names *thai* and *vividus* must hang upon the characters of topotypical females, which are probably not yet represented in any museum. If, contrary to my expectation, *thai* must eventually be united with *vividus*, it is believed that the unnecessary name will not unduly burden a future reviser, since the population of Ban Luang, while clearly showing the characters of the race, come from a locality at no great distance from the Amherst District. In this event, *vividus*, as here understood, will require a new name.

3. **Pericrocotus peregrinus sacerdos** Riley

Pericrocotus peregrinus sacerdos Riley, Proc. Biol. Soc. Washington **53**: 131. Nov. 8, 1940 (Sambor, Kompong Thom Province, Cambodia).

Diagnosis.—The adult male differs from those of *thai* and *vividus* by having the breast and rump rather more red, less orange, and the tips of the outer tail feathers more deeply colored.

The only adult female seen is inseparable from that of *vividus*.

Range.—Cambodia; Annam (south); Cochinchine?

Remarks.—Only five males of *sacerdos* have been available, but these seem to show that Riley's race may be recognized.

4. **Pericrocotus peregrinus separatus,** n. subsp.

Type.—Adult male, U.S.N.M. no. 173102, collected at Tanjong Badak, Mergui District, Tenasserim Division, Burma, on January 8, 1900, by W. L. Abbott.

Diagnosis.—The adult male differs from that of *vividus* (and so much the more from that of *thai*) by its decidedly longer and heavier bill, and from both by having the color of the underparts less vivid, the red being almost restricted to the upper breast, with the yellow accordingly of greater extent.

No adult female has been seen.

Range.—Burma (coasts and islands of the Mergui District); Siam (coasts and islands of the western side of the Peninsula from the Pak Chan Estuary to the Takua Pa Inlet).

Remarks.—This race, apparently confined to the mangroves of a limited part of the eastern shore of the Andaman Sea, is quite isolated from its relatives: *vividus* ranges southward in Tenasserim only to lat. 16°15′ N., and in southwestern Siam to lat. 11°40′ N., while *saturatus*

is restricted to the Greater Sundas, reaching Sumatra, but not the Malay Peninsula.

The large bill of *separatus* has already been commented upon by Robinson and Boden Kloss (Journ. Nat. Hist. Soc. Siam **5**: 251. 1924).

It will be a matter of some interest to learn whether the female has the color characters of *vividus* or of *saturatus;* it may be expected to resemble the latter.

5. **Pericrocotus peregrinus** subsp.

Baron R. Snouckaert van Schauburg (Treubia **11**: 311–312. 1930), with a single female before him, gave reasons for considering the birds of the Andaman Islands a distinct race. I have unfortunately but two adult males and one immature female from these islands. The males have the underparts as highly colored as the reddest examples of *thai* and the bill equal to that of *vividus* in size. Snouckaert van Schauburg's female had the underparts "wholly white, with a faint tinge of yellow on the flanks," thus evidently resembling the female of *saturatus* (and perhaps the still unknown female of *separatus*). Despite Whistler and Kinnear's dictum (Journ. Bombay Nat. Hist. Soc. **36**: 344. 1933) that a series from the Andamans can not be separated from "*vividus,*" it appears that the Andaman population can not be combined with any one of the several forms now recognized, and, were a name available, I should gladly accept it. I am not willing, however, to set up a new subspecies without having seen more material, and especially females.

Snouckaert van Schauburg has suggested that "in case it might be found that a local subspecies could indeed be established, I should like proposing to name it after Mr. B. B. OSMASTON who collected my bird." His "type," an adult female taken at Port Blair, South Andaman Island, on April 3, 1905, was in his private collection; its present whereabouts is unknown.

6. **Pericrocotus peregrinus saturatus** Stuart Baker

Pericrocotus peregrinus saturatus Stuart Baker, Bull. Brit. Orn. Club **40**: 115. Apr. 30, 1920 (West Java).

Diagnosis.—The adult male is inseparable from that of *vividus.*

The adult female has the flanks (and sometimes the abdomen) very lightly washed with pale yellow or cream and differs from that of *vividus* in the same degree as the female of *vividus* differs from that of *thai.*

Range.—Sumatra; Java; Bali.

Remarks.—Baker's setting up of the race *saturatus* throws an interesting light on his ornithological methods. In this particular revision he lists consecutively subspecies from (1) the Punjab, (2) Tenasserim, (3) the Malabar coast, (4) Sind, and (5) Java. No. 2 is discussed only in relation to no. 1, no. 3 only in relation to no. 2, and so on; in the end, the Javanese bird, no. 5, is distinguished, not from the geographically nearest form, but from the bird of Sind! Since the author considered the males of *vividus* and *saturatus* diagnostic (as is shown by his failure even to mention the females), it is certain that he could not have named the Javanese race at all, had he bothered to compare it with *vividus;* his "exceptionally dark birds above" has meaning only with reference to *pallidus!*

In any event, the population of Java, in which the male is like *vividus* and the female like *ceylonensis,* is a recognizable race, and Baker's name, however useless his type specimen, may properly be used for it.

I have seen no material from Sumatra and have simply followed other writers in including this island in the range of *saturatus.*

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ETHNOLOGY.—*Arikara glassworking.*[1] MATTHEW W. STIRLING, Bureau of American Ethnology.

A unique industry among American Indians, that of glassworking, was developed among the sedentary tribes of the Upper Missouri in the latter part of the eighteenth century and was carried on for perhaps a century. Although practiced among a number of different tribes, it is evident that the art was highly secret, and knowledge of it was confined to only a few individuals. Probably because of this fact satisfactory descriptions of the process are lacking, although it is mentioned by many early writers who visited the region and were impressed by the fact of its existence.

Joseph Garreau, who had lived for many years previously among the Upper Missouri tribes and who had an Arikara wife, explained the process of manufacturing glass ornaments to Lewis and Clark in 1804. As recorded by these American explorers the description is none too clear, but it gives nevertheless the general principles of the techniques:

Mr. Garrow a Frenchman who has lived many years with the Ricares & Mandans shewed us the process used by those Indians to make beads. the discovery of this art these nations are said to have derived from the Snake Indians who have been taken prisoners by the Ricaras. the art is kept a secret by the Indians among themselves and is yet known to but few of them. the Process is as follows.—Take glass of as many different colours as you think proper, then pound it as fine as possible, putting each colour in a separate vessel. wash the pounded Glass in several waters throwing off the water at each washing, continue this opperation as long as the pounded glass stains or colours the water which is poured off and the residuum is then prepared for use. you then provide an earthen pot of convenient size say of three gallons which will stand the fire; a platter also of the same material sufficiently small to be admitted in the mouth of the pot or jar. the pot has a nitch in it's edge through which to watch the beads when in blast. You then provide some well seasoned clay with a proportion of sand sufficient to prevent it's becoming very hard when exposed to the heat. this clay must be tempered with water until it is about the consistency of common doe. of this clay you then prepare, a sufficient number of little sticks of the size you wish the hole through the bead, which you do by roling the clay on the palm of the hand with your finger. this done put those sticks of clay on the platter and expose them to red heat for a few minutes when you take them off and suffer them to cool. the pot is also heated to cles [cleanse] it perfectly of any filth it may contain. small balls of clay are also mad[e] of about an ounce weight which serve as a pedestal for a bead. these while soft ar destributed over the face of the platter at su[c]h distance from each other as to prevent the beads from touching. some little wooden paddles are now provided from three to four inches in length sharpened or brought to a point at the extremity of the handle. With this paddle you place in the palm of the hand as much of the wet pounded glass as is necessary to make the bead of the size you wish it. it is then arranged with the paddle in an oblong from [form], laying one of those little stick of clay crosswise over it; the pounded glass by means of the paddle is then roped in cilindrical form arround the stick of clay and gently roled by motion of the hand backwards an forwards untill you get it as regular and smooth as you conveniently can. if you wish to introduce any other colour you now purforate the surface of the bead with the pointed end of your little paddle and fill up the cavity with other pounded glass of the colour you wish forming the whole as regular as you can. a hole is now made in the center of the little pedestals of clay with the handle of your shovel sufficiently large to admit the end of the stick of clay around which the bead is formed. the beads are then arranged perpendicularly on their pedestals and little distance above them supported by the little sticks of clay to which they are attached in the manner before mentioned. thus arranged the platter is deposited on burning coals or hot embers and the pot reversed with the apparture in its edge turned towards covers the whole. dry wood pretty much doated [doughted] is then

[1] Received April 22, 1947.

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plased arron [around] the pot in sush manner as compleatly to cover it. [It] is then set on fire and the opperator must shortly after begin to watch his beads through the apparture of the pot le[s]t they should be distroyed by being over heated. he suffers the beads to acquire a deepred heat from which when it passes in a small degree to a pailer or whitish red, or he discovers that the beads begin to become pointed at their extremities he removes the fire from about the pot and suffers the whole to cool gradually. the pot is then removed and the beads taken out. the clay which fills the hollow of the beads is picked out with an awl or nedle. the beads is then fit for uce. the Indians are extreemly fond of the large beads formed by this process. they use them as pendants to their years, or hair and sometimes wear them about their necks.[2]

This description apparently refers only to the manufacture of beads and not to the flatwork in which a greater amount of originality was displayed.

Washington Matthews, who was stationed at military posts on the Upper Missouri from 1865 to 1872, states that the art was still practiced occasionally at that time. He said that he had heard the process described by Indians essentially as given by Lewis and Clark. He added that formerly the articles manufactured consisted chiefly of two kinds—large globular or ellipsoidal beads; and flat, irregularly triangular plates or pendants, glazed only on one side and having a hole in the apex. In his time the art was mostly confined to the making of the flat, triangular pendants. Referring to the description given by Garreau to Lewis and Clark, Matthews says:

> From this quotation however, which is in part ambiguous, the inference might be drawn that the ornaments, when completed, consist entirely of glass. Such is not the case in those I have seen; on the contrary, they consist of a core of baked earth covered with a thin shell of glass; and they have the appearance of having been perforated before heat was applied. But, in the matter of making the holes, the process may have been changed, or there may have been two ways of doing it.[3]

As will appear later, both Matthews and Garreau were correct, since there is clear evidence that the process did change.

George Catlin, writing of the Mandan in 1837, says:

> In addition to this [potter's] art which I am sure belongs to no other tribe on the continent, these people have also, as a secret with themselves, the extraordinary art of manufacturing a very beautiful and lasting kind of blue glass beads, which they wear on their necks in great quantities and decidedly value above all others that are brought among them by the fur traders. This secret is not only one that the traders did not introduce among them, but one which they cannot learn from them; and at the same time, beyond a doubt an art that has been introduced among them by some civilized people, as it is yet unknown to other Indian tribes in that vicinity or elsewhere. Of this interesting fact, Lewis and Clarke gave an account thirty-three years ago, at a time when no traders or other white people had been among the Mandans to have taught them so curious an art.[4]

Catlin used this as one of his arguments to support his pet theory of the Welsh origin of the Mandans. In reference to his statement Matthews sagely remarks:

> It is surprising that Mr. Catlin, after reading the passages from Lewis and Clarke (and he leaves us to infer that he has read them) could state that the art of making these beads was confined to the Mandans: that it was unknown to the traders; that it was beyond doubt introduced by civilized people; and that no traders or other whites had been among these Indians before the time of Lewis and Clarke's visit.[5]

Maximilian, referring to his visit to the Upper Missouri in 1833, says:

> Among the Mandans, Minitaries and Arikkaras the women as Lewis and Clarke relate, manufacture beads from coloured glass. They powder those which they have obtained from the traders and mould them into different shapes. The custom is, however, no longer common.[6]

Hayden briefly mentioned the art among the Arikara, whom he visited in 1854:

> They also possess the art of melting beads of different colors, and casting them in moulds of clay for ornaments, some of which are very handsome.[7]

Denig who was engaged in the fur trade on the Missouri from 1833 to 1854 reported:

> They (the Arikara) also have the art of melting beads of different colors and casting them in

[2] Lewis and Clark, 1904, vol. 1, pp. 272–274.
[3] Matthews, 1877, pp. 19–23.
[4] Catlin, 1848, vol. 2, p. 201.
[5] Matthews, 1877, p. 22.
[6] Maximilian, 1843, p. 348.
[7] Hayden, 1862, p. 354.

molds of clay for ear and other ornaments of various shapes, some of which are very ingeniously done. We have seen some in shape and size as drawn in plate 65, the ground-work blue, the figure white, the whole about ⅛ inch thick and presenting a uniform glazed surface.[8]

Denig's illustration shows one of the triangular pendants with the inlaid figure of a woman, simply drawn.

George Bird Grinnell refers to the art as practiced by the Cheyenne:

Long, long ago, we are told, the Cheyennes manufactured for themselves what might be called beads, but perhaps were small charms made of some vitrified substance—perhaps of pulverized glass—after the white people were met. Such beads are said to have been made within two or three generations. Many of them were fashioned in the shape of a lizard; that is, a four-legged object with a long tail and a small head. The ceremony connected with making such objects was secret, and he who wished to possess one was obliged to go to some person who himself had been taught the ceremony, and to ask that person to teach him how to make one. A payment was made for the service. It is believed that in old times, long before the whites came, these beads were made from the quartz sand found on ant-hills, and that this was melted in an earthen pot. The secret of making them now seems to be lost.

In later times they melted the glass, with which to make the beads, in the ladles used in melting lead for their bullets. These ornaments or charms were made in various shapes, often in the form of a lizard, as said, or flat on one side and round on the other. Sometimes they had a perforation through which a string might be passed; at other times merely a constriction between two ends about which a string was tied. The mold was made of clay.

The first European beads possessed by the Cheyennes were white, coarse, and imperfect in finish, but were highly valued. Few of these are now in existence.[9]

In another place he states:

On the gently rising land to the west of the Porcupine village, the Cheyenne are said to have planted their corn . . . the village site now stands on the farm of Yellow Lodge, a Yankton Sioux who had been told by the old people that this was a Cheyenne village. In plowing he often turned up pottery. . . . He had turned up also glass beads, which he described as like the charms or beads which we know the Cheyennes used to manufacture—in later times perhaps from pounded glass like those said to have been made by the Mandan.[10]

[8] Denig, 1930, p. 413 and pl. 65.
[9] Grinnell, 1924, vol. 1, p. 223.
[10] Grinnell, 1918, p. 369.

In the early collections of the U. S. National Museum there is one of the triangular pendants, bleached apparently from exposure, bearing the label "Sioux stone charm" (Fig. 1, *f*). It may well be a specimen discovered in this manner by the Sioux.

James Mooney, referring to the period at the close of the nineteenth century, says in reference to the Cheyenne:

At least one man among them still understands the art of making beads and figures from pounded glass as formerly practised by the Mandan.[11]

As late as 1923, Melvin Gilmore obtained a brief account of glassworking from two old Arikara women. He also obtained from them a stone mortar said to have been used for the pulverizing of glass for reworking. When the informants were asked why the Arikara formerly went to the trouble of destroying the trader's beads in order to make them over, one of the women replied:

The traders of that time brought our people very large beads, as large as plums, and our people did not like them. For that reason they pulverized them, and worked them over into beads no larger than chokecherries, and also into pendants and other decorative forms.[12]

Regarding the process of manufacture these informants told Gilmore that—

the trader's beads were first pulverized, the different colored beads separately. Then they prepared a firing pan from the brass rim or binding of an old musket on which was laid a bed of sand. The powdered glass was moistened with water; then with a fine wooden tool this glass paste was shaped into the forms desired on the prepared bed of sand. The firing pan was carefully placed in a hot fire of dry elm wood, this wood being used because it would burn quietly without snapping or crackling. When heated to the proper temperature the glass paste became fused. Perforations were kept open by insertion of sand. When quite cooled after fusing, the beads or other objects were taken from the sand bed, and the sand was shaken out of the perforations.[13]

This account indicates that a reasonably accurate memory of the art was retained at a date at least 125 years after its adoption. The explanation that the trade beads were too large for the taste of the Indians is probably incorrect, since the early accounts indicate that the reverse was true.

[11] Mooney, 1907, article "Cheyenne."
[12] Gilmore, 1924, p. 20.
[13] Gilmore, 1924, p. 21.

The earliest reference to this subject known to the writer is that by Pierre Tabeau, who lived among the Arikara in 1802. Although brief it is of considerable importance. He says, after discussing the duties and occupations of women:

> A Spanish prisoner taught them how to melt our glass beads and to mould them into a shape that pleases them. This art which is as yet unknown to them is practised only secretly and still passes for a supernatural talent.[14]

There were three theories (not counting Catlin's Welsh theory) of the origin of the art. Of these, Tabeau's early statement that it was learned by the Indians from a Spanish prisoner seems the most probable. Garreau's statement that it came from the Shoshone seems improbable unless the above-mentioned Spanish prisoner came among these Indians from the Pacific coast.

Washington Matthews conjectured that the art was very old; that it was, in fact, an aboriginal invention discovered before the coming of the whites. He based this theory on the fact that it was highly improbable that any of the French traders who had been among the Indians would have had any knowledge of glassworking, and on Indian tradition that the art was very old. He states that the Indians had told him "with uncertainty" that in former times they found glass in the hills and pounded it for their beads.

The Indians might have had reference to obsidian or more likely the substance Culbertson refers to in his journal on the badlands of Dakota:

> I was much surprised to see, running through different parts of the clay surface, vertical strata of a singular looking substance something like melted glass and almost transparent; the strata are about one-fourth of an inch in thickness and do not lie in a series of strata, but between each stratum there are several inches of the clay . . . while in many places the surface is covered with small pieces. . . . [15]

Another reason Matthews gives for his theory of the antiquity of the practice is that—

> they used the triangular pendants, not as ornaments only, but as evidence of betrothal, as long ago as the oldest men can remember. When a girl was promised in marriage in her infancy by her parents, as was not infrequently done, one of these pendants was tied to her forelock so as to hang down over her forehead. When the promise was fulfilled, the husband removed the pendant and threw it away.[16]

The glasslike substance referred to by Culbertson was probably calcite. It seems quite certain that the firing method used by the Indians would not produce temperatures sufficiently high to fuse calcite, obsidian, or any other mineral substance occurring naturally in the region. It would appear therefore that any aboriginal practice of glassworking was beyond the capacities of the Indians.

In the summer of 1923 the writer conducted archeological investigations at the site of the Arikara village visited in 1804 by Lewis and Clark. During excavations in the cemetery of this village a considerable number of examples of this native glasswork were recovered. These consisted of beads of various sizes and flatwork ornaments. The majority of the beads were of solid, translucent, turquoise-blue glass, the few exceptions being either cloudy white or black. None of these contained inlay decorations. The smaller beads are of an oval shape with the perforations disproportionally large and having sharp, rough edges. Some of these are of excellent workmanship, while others are very inferior, being porous and full of impurities. The latter are dull in color and easily broken. These beads were all of the same blue color as the flatwork.

The large beads are of two shapes, ellipsoidal and roughly globular. The former have comparatively small perforations; the latter, large. The edges of the perforations are generally filled with bubbles, a characteristic seen also in the flatwork. In the burials these beads occurred sometimes in the form of necklaces, sometimes by the head, as if worn in the hair, and occasionally they were loose in leather or woven hair pouches.

The technique employed in the flat ornaments is exhibited in two shapes, triangular with rounded points, and circular.

[14] Abel, 1939, p. 149.
[15] Culbertson, 1851, p. 95.
[16] Matthews, 1877, p. 21.

The former have a hole at the apex, the latter in the center. The majority are of a solid blue color. Where two colors were used the base color is blue and the applied design is white. The usual design was for the base of the triangles to be decorated with hori-

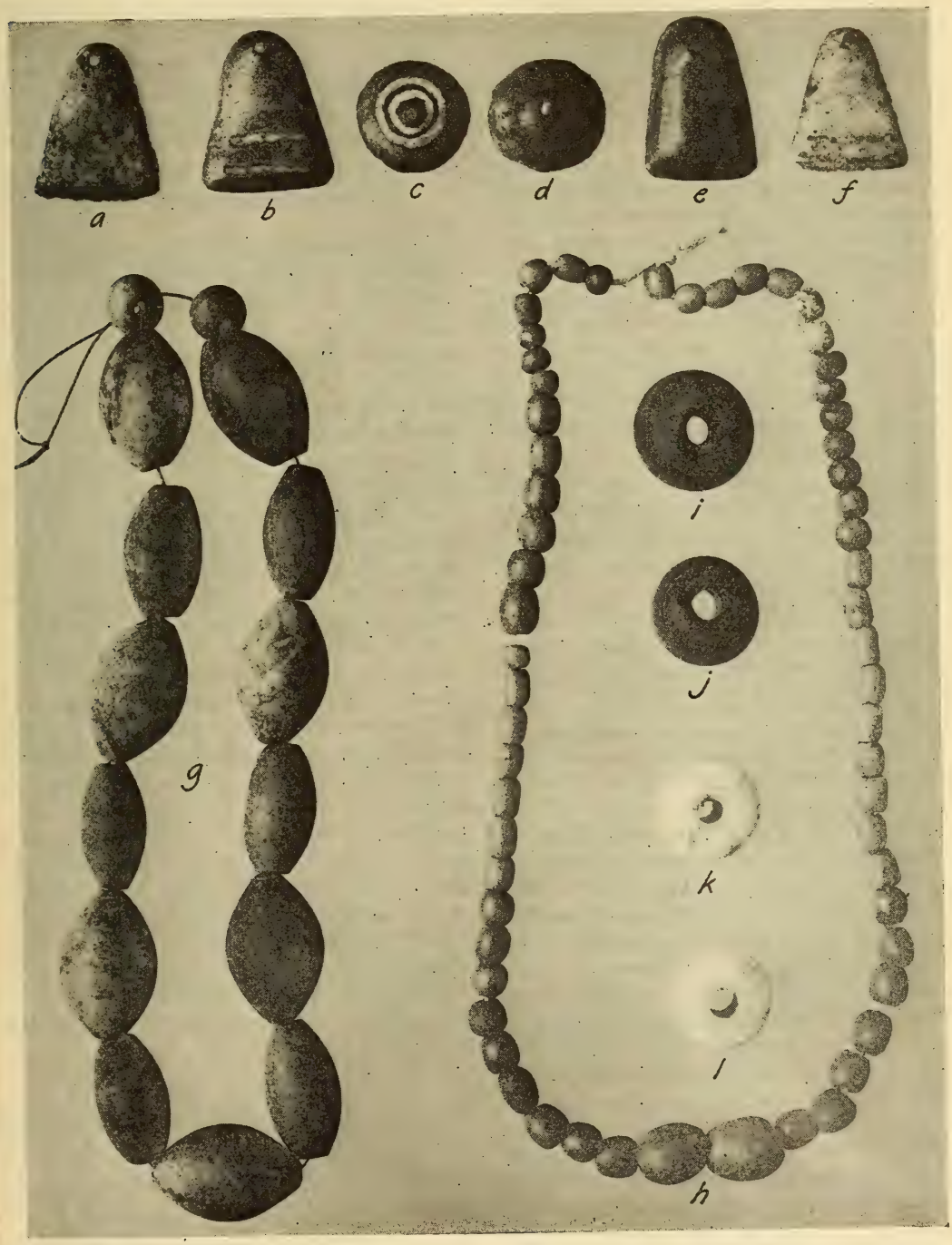


FIG. 2.—Glass beads and ornaments of Indian manufacture: *a–f*, Flatwork ornaments; *g*, *h*, turquoise-blue beads; *i*, *j*, black spherical beads; *k*, *l*, white spherical beads. Three-fourths natural size.

zontally placed bars and dots (Fig. 1, *a, b, f*); the disks with concentric circles (Fig. 1, *c*). One example of this glass was ground to an oblong shape. It was unperforated and gives the impression of imitation turquoise. All the flatwork is convex on the upper surface and typically has a glossy finish, while the under surface is dull and perfectly flat.

In one grave a single disk was found by the head of the burial, and two triangular ornaments were in position as ear pendants. In another grave 17 disks and 4 triangles were found attached as ornaments on a woven buffalo hair bag. These were fastened in a novel manner. A white bead, small enough to fit into the hole but large enough not to pass through, was used as a stay or key. The bead was threaded through the hole in the flat piece and thus held tightly against the woven surface or skin to which it was attached.

It might be added that quantities of small trade beads of the same shade of blue were found with many of the burials and presumably this was the type of bead ground up for reworking.

Matthews said:

> I had two of the triangular pendants made to order in 1870, by an Arickaree woman, to whom I furnished the blue glass necessary. When I gave instructions to have the articles made, I was invited to witness the process, but circumstances prevented me from doing so. One of these pendants was sent to the Smithsonian Institution.[17]

The writer located this example in the collections of the Division of Ethnology in the U. S. National Museum, and it is here figured (Fig. 1, *e*). Another specimen was also discovered in the collections labeled as a "Sioux stone charm." This has already been commented upon. These two specimens differ from the archeological examples in one important respect. They consist of a clay core, enameled with glass, whereas the older examples are of pure glass and are translucent.

While the ornaments themselves are inferior to the early examples, the workmanship in one respect shows an advance. The use of a clay core results in a considerable saving of material and also greatly facilitates the process of manufacture. Aside from these two examples, no others except those found in the above-mentioned archeological excavations are known to the writer.

The ornament made for Matthews is a darker shade of blue than the other examples. This is probably because the beads he furnished for the purpose were of a darker shade than the earlier trade beads and also because of the opaque nature of the subject.

The method described by Garreau is what would be called by modern glassworkers a Sintering or Fritting process, and it is a highly skilled craft, especially where the paraphernalia used is so crude. For the process to be successful the grading of the powdered glass must be properly done and exactly the right amount of moisture added to the powdered mixture. If too much water is present, bubbles form or the object falls apart on heating. Determining the critical point in the firing as described by Garreau is the crucial point in the whole process. The application of heat must be stopped at precisely the proper moment. If it proceeds only a brief moment beyond, the object melts down. If it is stopped too soon the firing is incomplete. Even modern glaziers with instruments and temperature controls to aid them are considered highly skilled when they can perform this operation successfully.

One essential stage in the process has been omitted by Garreau. The objects can not be modeled and fused by the addition of water alone. Some other binding agency must be used. Modern glassworkers use gum arabic or some similar substance, but saliva will serve the purpose, and it might well be that this was the method employed by the Indians.[18]

[17] Matthews, 1877, p. 21.

[18] Information furnished by L. B. Clark, Division of Radiation and Organisms, Smithsonian Institution.

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ENTOMOLOGY.—*Notes on, and new species of, American moths of the genus* Filatima *Busck (Gelechiidae: Lepidoptera).*[1]

J. F. Gates Clarke, U. S. Bureau of Entomology and Plant Quarantine.

In this paper I have assigned three species, previously unrecognized by Busck[2] and not placed in his paper on the restriction of *Gelechia*, to *Filatima*. A fourth species, referred to *Filatima*, is herein transferred, and 12 new species are described.

The drawings for this paper were made by the author.

Filatima procedes, n. sp.
Figs. 1–1b, 14

Labial palpus shining whitish buff; brush of second segment suffused with drab and irrorate with fuscous; third segment irrorate with blackish fuscous. Antenna whitish buff with blackish-fuscous annulations. Ground color of head, thorax, and forewing whitish buff, the scales tipped with cinnamon-buff and somewhat suffused with fuscous, this combination of color producing a general drab appearance; in the fold, at basal third, an ill-defined cinnamon-buff spot; discal spots, if present, small and blackish fuscous; cilia sordid whitish buff speckled with blackish fuscous; underside with rather conspicuous blackish-fuscous scaling. Hind wing shining whitish basally shading to fuscous apically; cilia yellowish fuscous; curtain scaling from underside of costa present in male. Legs whitish buff irrorate with blackish fuscous; tibial spurs blackish fuscous outwardly. Abdomen with first three segments yellowish above, remainder fuscous, edged with whitish buff; beneath whitish buff, irrorate with blackish fuscous.

Male genitalia.—Asymmetrical. Ventral lobe of left harpe stout with a large, conspicuous, strongly sclerotized tooth on the inner surface just before apex, several smaller teeth on the inner surface, and a large one at the junction of the ventral and dorsal lobes; dorsal lobe slender, fleshy. Right harpe with ventral lobe rather slender, smooth; dorsal lobe slender, fleshy. Gnathos a small hook with a few teeth on the posteroventral edge. Uncus narrow, weak. Aedeagus with a large, sharp tooth, directed forward, on left side, and a thornlike process posteriorly from the right side.

Female genitalia.—See Fig. 14.

Alar expanse, 18–20 mm.

Type.—U.S.N.M. no. 58257.

Type locality.—Presidio, Tex.

Food plant.—*Salix exigua* Nutt.

Remarks.—Described from the male type, three male and one female paratypes, all from the same locality. The moths emerged 22-X-1943 from larvae collected 17–IX–1943 by J. H. Russell. Paratypes in the U. S. National Museum and the British Museum.

This species is closely related to *F. saliciphaga* (Keifer) but averages lighter in color

[1] Received February 4, 1947.

[2] Busck, A., *Restriction of the genus* Gelechia *(Lepidoptera: Gelechiidae), with descriptions of new species.* Proc. U. S. Nat. Mus. **86**: 563–593. pls. 58–71. 1939.

and smaller in size. In the male genitalia of *saliciphaga* there is a pronounced "shoulder" from the ventral edge of the ventral lobe of each harpe which is entirely lacking in *procedes*, and the toothlike processes of the aedeagus are nearly twice as large in *saliciphaga* as they are in *procedes*.

Filatima betulae, n. sp.

Figs. 2–2b, 15

Labial palpus sordid white suffused and heavily overlaid with fuscous; third segment almost wholly dark fuscous with a sprinkling of sordid white scales. Antenna dark fuscous annulated with gray. Head grayish fuscous, the scales broadly tipped with dark fuscous. Thorax and ground color of forewing brown; narrowly along costa, indistinctly on the veins and broadly on dorsum overlaid with dark fuscous-tipped grayish-fuscous scales; at apical fourth and at tornus an indistinct sordid white spot faintly indicating a transverse line; cilia light yellowish fuscous irrorate with blackish fuscous. Hind wing gray shading to fuscous around margins; cilia yellowish fuscous with darker shading at middle; curtain scaling present in male. Legs sordid white suffused and banded with blackish fuscous.

Male genitalia.—Asymmetrical. Ventral lobe of left harpe half as broad as long, terminating in three widely separated points; ventral lobe of right harpe ending in a single point. Gnathos a short hook with serrate ventroposterior edge. Aedeagus with prominent lateral point and one stout, pointed cornutus.

Female genitalia.—Ostium broad. Ductus bursae sclerotized for almost its entire length. Signum a large 2-pointed plate.

Alar expanse, 19–21 mm.

Type.—U.S.N.M. no. 58250.

Type locality.—Melrose Highlands, Mass.

Food plant.—*Betula populifolia* Marsh.

Remarks.—Described from the male type and one female paratype (5-VI and 15-VI-1931). Paratype in the U. S. National Museum.

In genitalia this species is nearest *F. roceliella* Clarke, but differs from it as follows: Both harpes of *roceliella* are nearly symmetrical while those of *betulae* are strongly asymmetrical as shown in the figure.

Filatima golovina, n. sp.

Figs. 3–3b, 21

Labial palpus white inwardly on second segment, pale ocherous in the brush and irrorate with blackish fuscous; third segment white irrorate with blackish fuscous. Antenna blackish fuscous with indistinct narrow annulations. Head sordid white, the tips of the scales narrowly edged with fuscous. Tegula fuscous basally shading to sordid white apically. Thorax and forewing sordid white, the ground color nearly obliterated by fuscous and other markings; from base, inside costa, to and including apex, ocherous scaling gradually broadening to include nearly the whole apical third of wing; a white spot on costa and another on tornus indicate an obsolete transverse fascia; discal spots generally ill-defined or absent, but when present four in number and fuscous (the females are more conspicuously marked than the males): cilia gray to grayish fuscous, irrorate with fuscous. Hind wing shining grayish fuscous basally shading to fuscous around margins; cilia yellowish fuscous; curtain scaling from underside of costa present in male. Legs white, irrorate and banded with blackish fuscous. Abdomen light fuscous above, the segments edged with white posteriorly, except the first three segments which are yellowish; beneath white broadly edged with fuscous ventrolaterally.

Male genitalia.—Asymmetrical. Ventral lobe of left harpe strongly curved and studded with small teeth on its inner surface and outer edge. Ventral lobe of right harpe deeply emarginate on ventral edge. Gnathos a short, stout hook with three or four teeth on ventroposterior edge. Aedeagus with a large pointed process from the left side and a small thornlike cornutus on the right.

Female genitalia.—The signum, though of the usual type for this genus, is unusually small in this species.

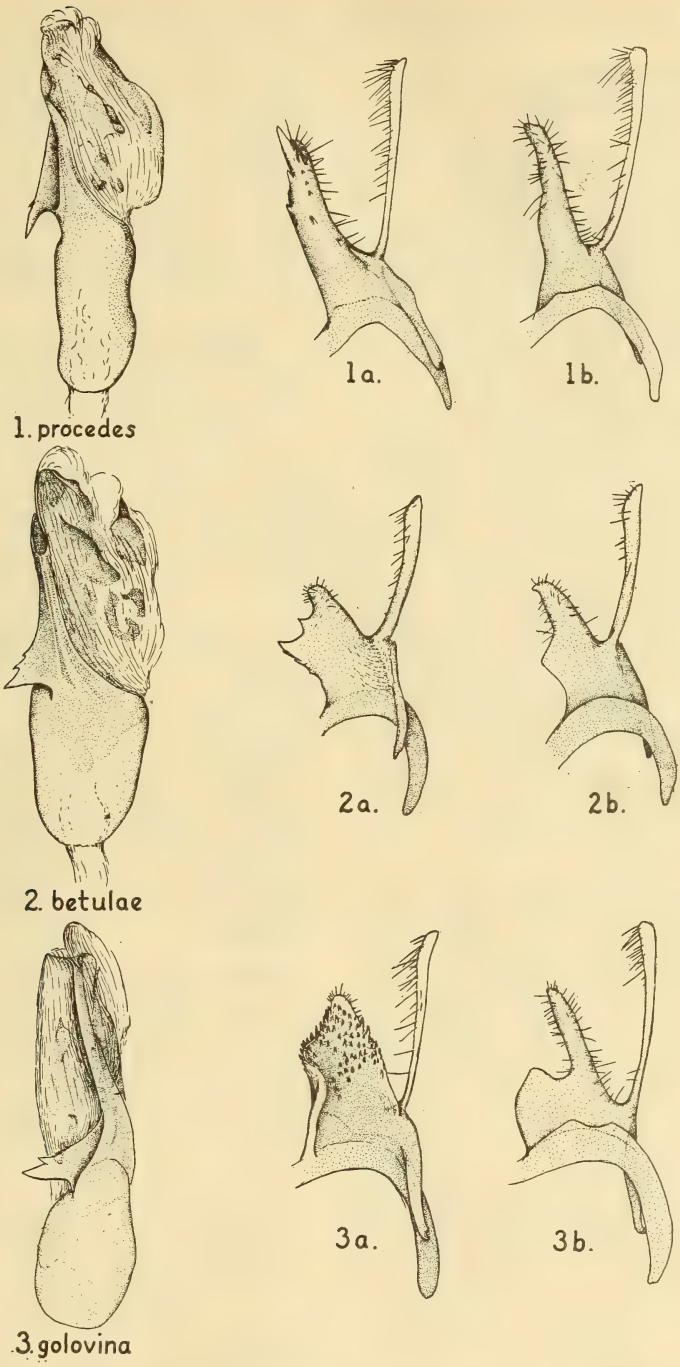
Alar expanse, 18–20 mm.

Type.—U.S.N.M. no. 58253.

Type locality.—Palm Springs, Calif.

Remarks.—Described from the male type, two male and four female paratypes from California as follows: Palm Springs, type male (2-V-1921, Karl R. Coolidge) and female (6-V-1921, Karl R. Coolidge); Dixieland, Imperial County, two males and three females (15-IV to 15-V-1922, O. C. Poling). Paratypes in the U. S. National Museum and the British Museum.

The pattern of this species is similar to that of *sperryi*, but *golovina* is much lighter in colora-



Male Genitalia

Figs. 1–1b.—*Filatima procedes*, n. sp.: 1, Ventral view of aedeagus; 1a, inner surface of left harpe; 1b, outer surface of right harpe.

Figs. 2–2b.—*Filatima betulae*, n. sp.: 2, Ventral view of aedeagus; 2a, inner surface of left harpe; 2b, outer surface of right harpe.

Figs. 3–3b.—*Filatima golovina*, n. sp.: 3, Lateral view of aedeagus to show spinous process; 3a, inner surface of left harpe; 3b, outer surface of right harpe.

tion. The two can be distinguished easily by their genitalia.

Filatima tridentata, n. sp.
Figs. 9–9b, 19

Labial palpus ocherous-white suffused and overlaid with fuscous; third segment lightly and finely irrorate with fuscous but lacking annuli. Antenna fuscous with ill-defined lighter annulations. Head, thorax, and forewing yellowish brown; many of the scales of the head and thorax, and a few of the forewing, narrowly tipped with fuscous; basal angle with a conspicuous, oblique black dash; at the end of cell a poorly defined blackish fuscous spot with a scattering of yellowish scales irregularly placed around it; in cell, at basal two-fifths a smaller, similarly colored spot; at apical fourth on costa, a narrow, but distinct, pale spot indicating the position of an obsolete transverse fascia; around apex and termen an indistinct row of small blackish fuscous spots; cilia pale yellowish fuscous irrorate with fuscous. Hind wing grayish fuscous basally shading to dark fuscous around the margins; cilia pale yellowish fuscous with a faint, narrow, fuscous subbasal band; curtain scaling present from underside of costa of male. Legs ocherous-white marked and annulated with blackish fuscous. Abdomen light yellowish fuscous overlaid with black beneath.

Male genitalia.—Almost symmetrical. Ventral lobe of the left harpe slightly broader than the corresponding lobe of the right harpe; dorsal and ventral lobes of both harpes of about equal length, approximately one-half the length of the tegumen. Aedeagus with a long, narrow three-pointed plate on right side and a spinous process, turned dorsad, near base on left side. Gnathos a short hook with serrate ventroposterior edge.

Female genitalia.—Ostium broad, opening into the wide ductus bursae; ductus bursae sclerotized for about half its length posteriorly and studded with numerous fine spines and minute scobinations. Bursa copulatrix with a very wide two-pointed signum; ductus seminalis from a small posteroventral evagination of the bursa copulatrix.

Alar expanse, 20–23 mm.

Type.—U.S.N.M. no. 58249.

Type locality.—Snow Creek, Riverside County, Calif.

Food plant.—"Willow."

Remarks.—Described from the male type and two female paratypes, all reared by Commander C. M. Dammers. The emergence dates are: Male type, 21-X, and female, 21-X-1933 (Snow Creek), and female, 26-IX-1938 (Riverside). Paratypes in the U. S. National Museum.

This species belongs in the *serotinella-abactella* group and probably is more nearly related to *abactella.* The yellowish-brown forewing will distinguish *tridentata* from the other species of the group.

Filatima shastella (Gaede), n. comb.

Gelechia albifemorella Clarke (*not* Hoffmann), Can. Ent. **64**: 65, pl. 2, fig. 6, pl. 3, fig. 5. 1932. —McDunnough, Check list of the Lepidoptera of Canada and the United States of America (part 2, Microlepidoptera). No. 8123. 1939.

Gelechia shastella Gaede, *in* Bryk, Lepidopterorum Catalogus, pt. 79: 212. 1937.

Filatima clarkella Busck, Proc. U. S. Nat. Mus. **86**: 576. 1939. (New synonymy.)

When I described this species I was unaware of the previous use of the name *albifemorella* by Hoffmann (Ent. Zeit. Stettin **28**: 204. 1867), and thus created a primary homonym. Busck brought this to my attention several years later, proposed the new name *clarkella,* and assigned the species to *Filatima* where it belongs. At that time (1939) Busck had not seen part 79 of the Lepidopterorum Catalogus in which Gaede proposed the name *shastella* for *albifemorella* Clarke. Thus Busck's name falls as a synonym of *shastella.*

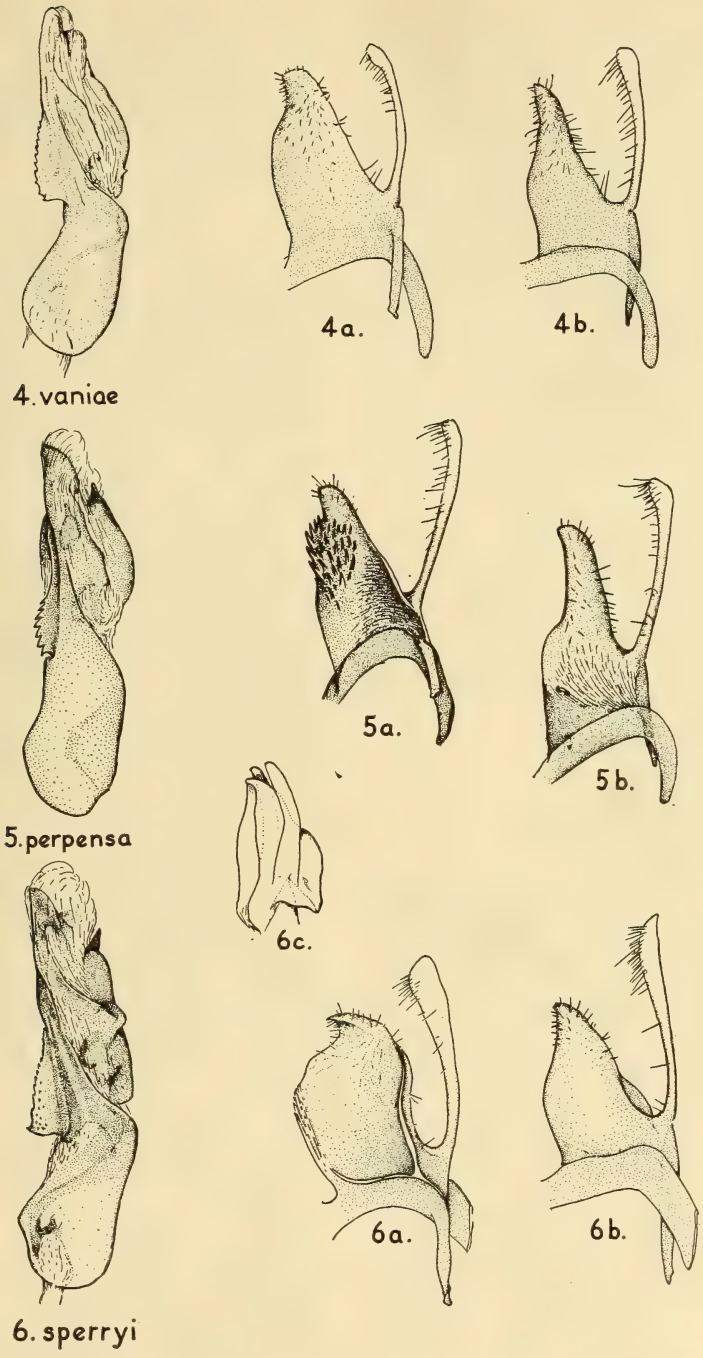
Filatima prognosticata (Braun), n. comb.

Gelechia prognosticata Braun, Trans. Amer. Ent. Soc. **51**: 195. 1925.—Busck, Proc. U. S. Nat. Mus. **86**: 589. 1939.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America (part 2, Microlepidoptera), No. 8119. 1939.

Dr. Annette F. Braun has compared the type of her species with *vaniae* (described below) and confirmed the close relationship of the two. I hereby assign *prognosticata* to *Filatima.*

Filatima vaniae, n. sp.
Figs. 4–4b, 17

Labial palpus white inwardly, suffused and irrorate with fuscous in brush and exteriorly on second segment; third segment almost entirely overlaid with blackish fuscous. Antenna fuscous with poorly defined lighter annulations. Head pale gray, the scales tipped with fuscous. Thorax and forewing very pale gray to whitish,



Male Genitalia

Figs. 4–4b.—*Filatima vaniae*, n. sp.: 4, Ventral view of aedeagus; 4a, inner surface of left harpe; 4b, outer surface of right harpe.

Figs. 5–5b.—*Filatima perpensa*, n. sp.: 5, Ventral view of aedeagus; 5a, inner surface of left harpe; 5b, outer surface of right harpe.

Figs. 6–6c.—*Filatima sperryi*, n. sp.: 6, Ventral view of aedeagus; 6a, inner surface of left harpe; 6b, outer surface of right harpe; 6c, ventrolateral aspect of uncus showing lateral rods.

the scales tipped with fuscous; from base to apex, in the costal third, is an ochraceous-tawny shade, the extent of which varies individually; at apical fourth is an ill-defined whitish transverse fascia; in the fold a dark fuscous, elongate dash is edged with tawny scales; discal spot at end of cell fuscous, small; remaining spots obsolete, or when present indistinct, fuscous; cilia pale fuscous irrorate with darker fuscous. Hind wing light grayish fuscous narrowly edged with dark fuscous; cilia pale fuscous; curtain scaling from the underside of costa present in male. Legs white, densely dusted and banded with blackish fuscous. Abdomen with first three segments yellowish above, remainder light fuscous edged posteriorly with sordid white; beneath white dusted and suffused with dark fuscous.

Male genitalia.—Asymmetrical. Left harpe with ventral lobe nearly twice the size of the corresponding member of the right harpe. Gnathos a long curved hook. Aedeagus with a serrate carinate process on the left side and an elongate plate with two small thornlike teeth on the right side.

Female genitalia.—See Fig. 17.

Alar expanse, 15–18 mm.

Type.—U.S.N.M. no. 58255.

Type locality.—Murray, Utah.

Food plant.—*Ribes* sp.

Remarks.—Described from the male type, one male and five female paratypes all from the type locality. The moths were reared from larvae on *Ribes* collected by P. H. Timberlake. The emergence dates are from July 1 to July 12, 1913. Paratypes in the U. S. National Museum, the British Museum, and in the collection of Dr. Annette F. Braun, Cincinnati, Ohio.

This species is close to *prognosticata* Braun, and the larvae feed on the same food plant. Dr. Braun has been kind enough to compare *vaniae* with her species and has written me as follows: "In *prognosticata* the scales dorsad of the fringe on the lower side of the hind wing of the male, are much longer than in your specimen, with the scales overlapping; this difference is most noticeable between veins 1c and 2. Your specimen has these scales short and not overlapping. Otherwise the specimens, as to wing markings and palpi, are identical, except that yours are smaller and paler. The scaling of the hind wing of yours is more like that of *xanthuris* Meyrick than it is like *prognosticata*. It would appear that they are distinct, in spite of the same food plant."

F. prognosticata averages considerably larger than *vaniae*, the largest specimen of the latter just attaining the size of the smallest specimen of the former.

Filatima perpensa, n. sp.
Figs. 5–5b

Labial palpus sordid white, mottled, and overlaid with blackish fuscous. Antenna blackish fuscous. Head varying from grayish to light fuscous, the scales tipped with dark fuscous. Thorax and forewing fuscous, streaked and overlaid with brownish-ocherous scales; tegula tipped with brownish ocherous; basal angle marked with a black dash, but this obsolete in some specimens; on anal vein at basal third, slightly above this in cell and at end of cell, small blackish fuscous spots; the one at the end of cell frequently in the form of a short, outwardly oblique, broad dash and all of the spots obsolete in some specimens; at apical fourth an ill-defined pale costal spot indicates an obsolete transverse line; cilia pale fuscous irrorate with fuscous. Hind wing dark fuscous; cilia pale fuscous; curtain scaling on underside present in male. Legs blackish fuscous annulated and banded with pale yellowish fuscous. Abdomen blackish fuscous with a broad, sordid ocherous white, longitudinal median area.

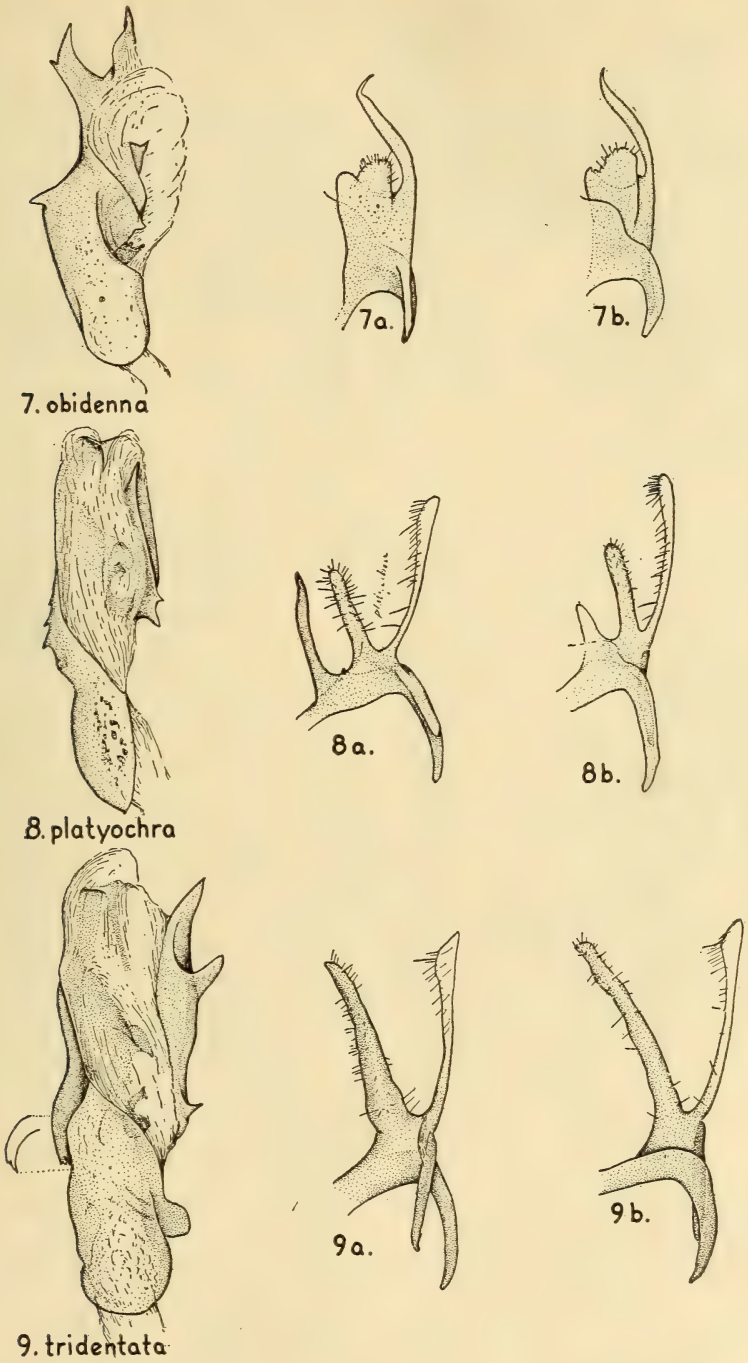
Male genitalia.—Asymmetrical. Ventral lobe of left harpe broader than the corresponding member of the right harpe and studded with short, sharp teeth on its inner surface. Aedeagus with a serrate carinate process on the left side and two strong thornlike cornuti on the right side.

Alar expanse, 18–22 mm.

Type.—U.S.N.M. no. 58248.

Type locality.—The Geysers, Sonoma County, Calif.

Remarks.—Described from the male type (21-VI-1938) and 14 male paratypes from California as follows: Male, The Geysers, Sonoma County (21-VI-1938); 7 males, Pinnacles, San Benito County (May and June dates); male, Beaumont (21-VII-1935); 2 males, Las Lomas Ranch, Sonoma County (30-V-1936); male, Hawthorne (13-VI-1937); male, Palm Springs (10-VI-1937); male, Glen Ellen (10-VII-36). All were collected by E. C. Johnston.



Male Genitalia

Figs. 7–7b.—*Filatima obidenna*, n. sp.: 7, ventral view of aedeagus; 7a, inner surface of left harpe; 7b, outer surface of right harpe.

Figs. 8–8b.—*Filatima platyochra*, n. sp.: 8, Ventral view of aedeagus; 8a, inner surface of left harpe; 8b, outer surface of right harpe.

Figs. 9–9b.—*Filatima tridentata*, n. sp.: 9, Ventral view of aedeagus; 9a, inner surface of left harpe; 9b, outer surface of right harpe.

Paratypes in the U. S. National Museum, the British Museum, and the E. C. Johnston collection.

The variability of this species renders it difficult to separate on superficial characters, but the spinose inner surface of the left harpe distinguishes it from any other described *Filatima* except *golovina*. A comparison of Figs. 3 and 5 shows clearly the differences between *golovina* and *perpensa*.

The nearest relatives are *F. serotinella* (Busck) and *F. gilvomaculella* (Clem.), but the ventral edge of the ventral lobe of the left harpe of these two is serrate, a character not found in *perpensa*.

Filatima sperryi, n. sp.
Figs. 6–6c

Labial palpus sordid white so heavily overlaid with dull black as to obscure the ground color; apex of second segment narrowly edged with sordid white. Antenna blackish fuscous with indistinct, narrow, lighter annulations. Head and thorax cinerous, the scales broadly tipped with dark fuscous; face sordid white. Forewing with extreme costal edge, a narrow line around apex and termen and a broad, elongate area from base of wing to tornus, blackish fuscous; remainder of wing buckthorn brown; on costa and tornus a small whitish spot indicating the position of an obsolete transverse fascia; discal spots absent; in some specimens is a dusting of dark fuscous scaling in the light apical portion of the wing; cilia grayish fuscous with blackish fuscous irrorations. Hind wing pale fuscous basally shading to fuscous apically; cilia pale fuscous with ill-defined, darker, narrow bands; curtain scaling from underside of costa present in male. Legs shining creamy white overlaid and banded with blackish fuscous. Abdomen fuscous above, the segments edged with whitish posteriorly; creamy white below with fuscous laterally.

Male genitalia.—Asymmetrical. Left harpe with a very broad ventral lobe, the ventral edge of which is rugose; dorsal lobe slender, weak, dilated distally. Right harpe with ventral lobe triangular and with a carinate process from base; dorsal lobe slender, weak. Gnathos a long, slender hook. Uncus with narrow, flattened, lateral, sclerotized processes projecting beyond distal end. Aedeagus with long sawlike process on left side and an elongate, narrow sclerotized plate with two teeth (occasionally one by obsolescence), one at each end.

Alar expanse, 18–21 mm.

Type.—U.S.N.M. no. 58251.

Type locality.—Barton Flats,[3] Calif.

Remarks.—Described from the male type and three male paratypes as follows: California: Barton Flats (4-VIII-1945, A. L. Melander); Nevada: White Mountains (10-VIII-1937, A. Little); Utah: Eureka (16-VII-1911 and 28-VII-1911, Tom Spalding). Paratypes in the U. S. National Museum, the British Museum, and in the collection of John L. and Grace H. Sperry (Nevada specimen) of Riverside, Calif.

I take pleasure in naming this species for my friend John L. Sperry, from whom the type and the Nevada specimen were received. Mr. Sperry has contributed consistently and greatly to our knowledge of western Lepidoptera.

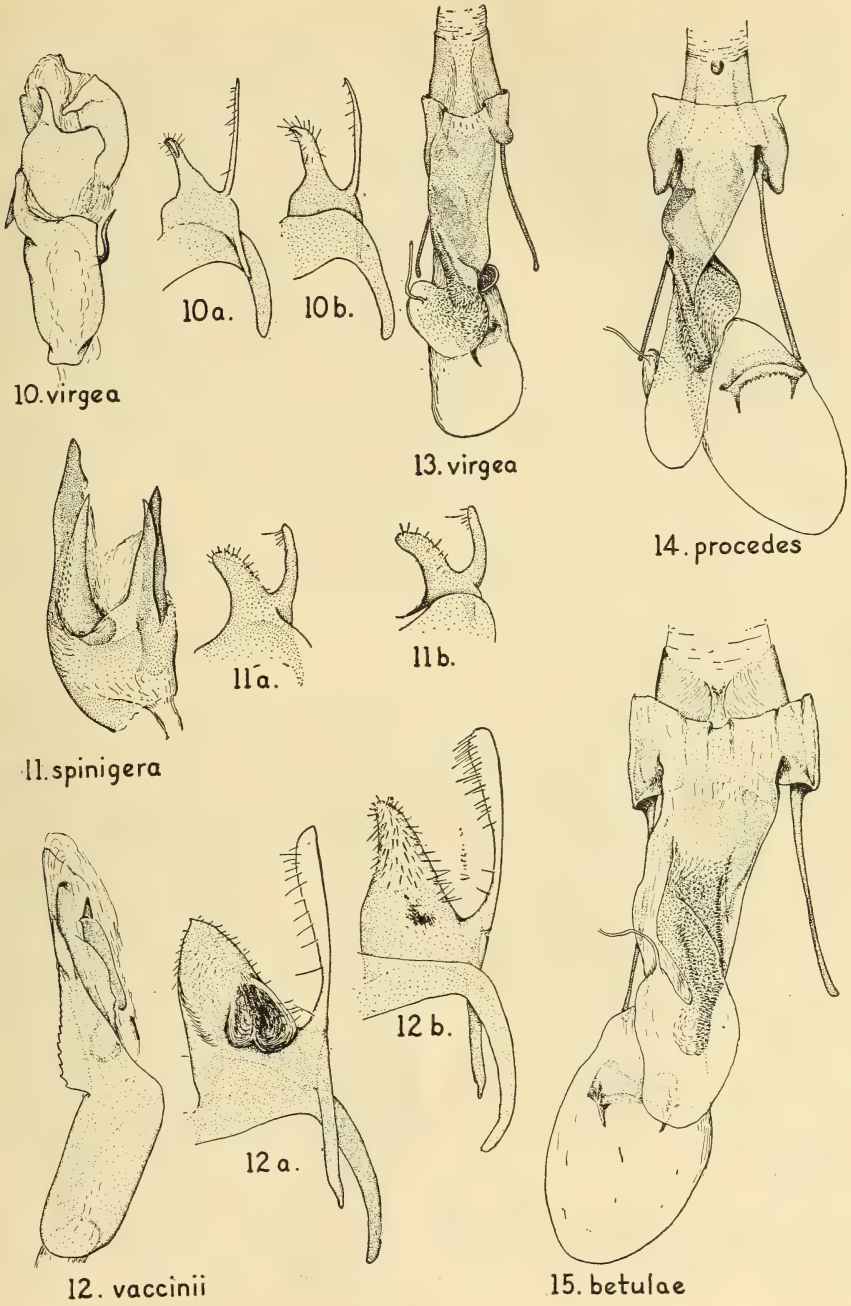
Filatima vaccinii, n. sp.
Figs. 12–12b, 20

Labial palpus white inwardly on second segment, suffused and heavily overlaid with dark gray and blackish fuscous in the brush and outwardly; third segment with only a fine line of white visible on the inner side. Antenna fuscous with pale grayish annulations. Head, thorax, and forewing gray, each scale tipped with fuscous, the moth appearing gray; four small spots on fold and in the cell fuscous if present, but only faintly indicated in one specimen; at apical fourth, from costa to tornus, an ill-defined narrow, outwardly convex transverse fascia; cilia gray irrorate with fuscous. Hind wing fuscous with a brassy hue, darker apically than basally; cilia light fuscous; curtain scaling from underside of costa present in male. Legs shining white, overlaid, and banded with blackish fuscous.

Male genitalia.—Asymmetrical. Left harpe with large concavity on inner surface near junction of ventral and dorsal lobes. Ventral lobe of right harpe narrow, triangular, smooth. Gnathos a large hook, abruptly curved distally. Aedeagus with dentate carinate process on left side and elongate, sclerotized plate with one thornlike process distally on right side.

Female genitalia.—See Fig. 20.

[3] The exact location of Barton Flats is not clear, but presumably it refers to the locality in Fresno County, near Fresno.



Male and Female Genitalia

Figs. 10–10b.—*Filatima virgea*, n. sp.: 10, Ventral view of aedeagus; 10a, inner surface of left harpe; 10b, outer surface of right harpe.

Figs. 11–11b.—*Filatima spinigera*, n. sp.: 11, Ventral view of aedeagus; 11a, inner surface of left harpe; 11b, outer surface of right harpe.

Figs. 12–12b.—*Filatima vaccinii*, n. sp.: 12, Ventral view of aedeagus; 12a, inner surface of left harpe; 12b, outer surface of right harpe.

Fig. 13.—*Filatima virgea*, n. sp.: Female genitalia, ventral view.

Fig. 14.—*Filatima procedes*, n. sp.: Female genitalia, ventral view.

Fig. 15.—*Filatima betulae*, n. sp.: Female genitalia, ventral view.

Alar expanse, 16–18 mm.

Type.—U.S.N.M. no. 58254.

Type locality.—Toms River, N. J.

Food plant.—*Vaccinium vacillans* Solander.

Remarks.—Described from the male type, one male and one female paratypes all from the same locality. The moths emerged 30-VI-1923 from larvae collected by H. B. Scammell. Paratypes in the U. S. National Museum.

Filatima platyochra, n. sp.
Figs. 8–8b, 16

Labial palpus white with slight fuscous dusting exteriorly on the second segment and more profuse dusting on the third segment. Antenna fuscous with paler annulations. Head, thorax, and ground color of forewing sordid white heavily overlaid with drab; face, and a spot on each side of the thorax posterolaterally, white; on costa and tornus white spots indicate an obsolete transverse line at apical fourth; a dash in fold, about middle, and discal spots at center and end of cell, sepia, broadly edged with white; along costa and following veins some brownish ocherous scales; cilia gray to pale fuscous irrorate with fuscous. Hind wing pale shining gray basally shading to fuscous around the margins; cilia pale fuscous with two darker bands faintly indicated; curtain scaling from underside of costa present in male. Legs white lightly dusted with fuscous; tarsi banded with fuscous. Abdomen white except for dorsal surfaces of first three segments, which are yellowish, and narrow fuscous shading ventrolaterally the entire length of the abdomen.

Male genitalia.—Asymmetrical. Left harpe divided into three fingerlike parts. Right harpe divided into three parts, the ventral one of which is the shorter and the dorsal arm the longer. Gnathos a short stout hook with serrate posteroventral edge. Aedeagus with a serrate edge, bearing three teeth, on the left and a sclerotized plate on the right having a thornlike tooth distally and broad, divided process proximally.

Female genitalia.—See Fig. 16.

Alar expanse, 17–18 mm.

Type.—U.S.N.M. no. 58256.

Type locality.—Dixieland, Imperial County, Calif.

Remarks.—Described from the male type and two female paratypes, all from the type locality. These were collected April 15–30, 1922 (type and one paratype), and May 1–15, 1922 (one paratype), by O. C. Poling. Paratypes in the U. S. National Museum.

I know of no other described *Filatima* with male genitalia comparable to those of *platyochra*.

Filatima frugalis (Braun), n. comb.

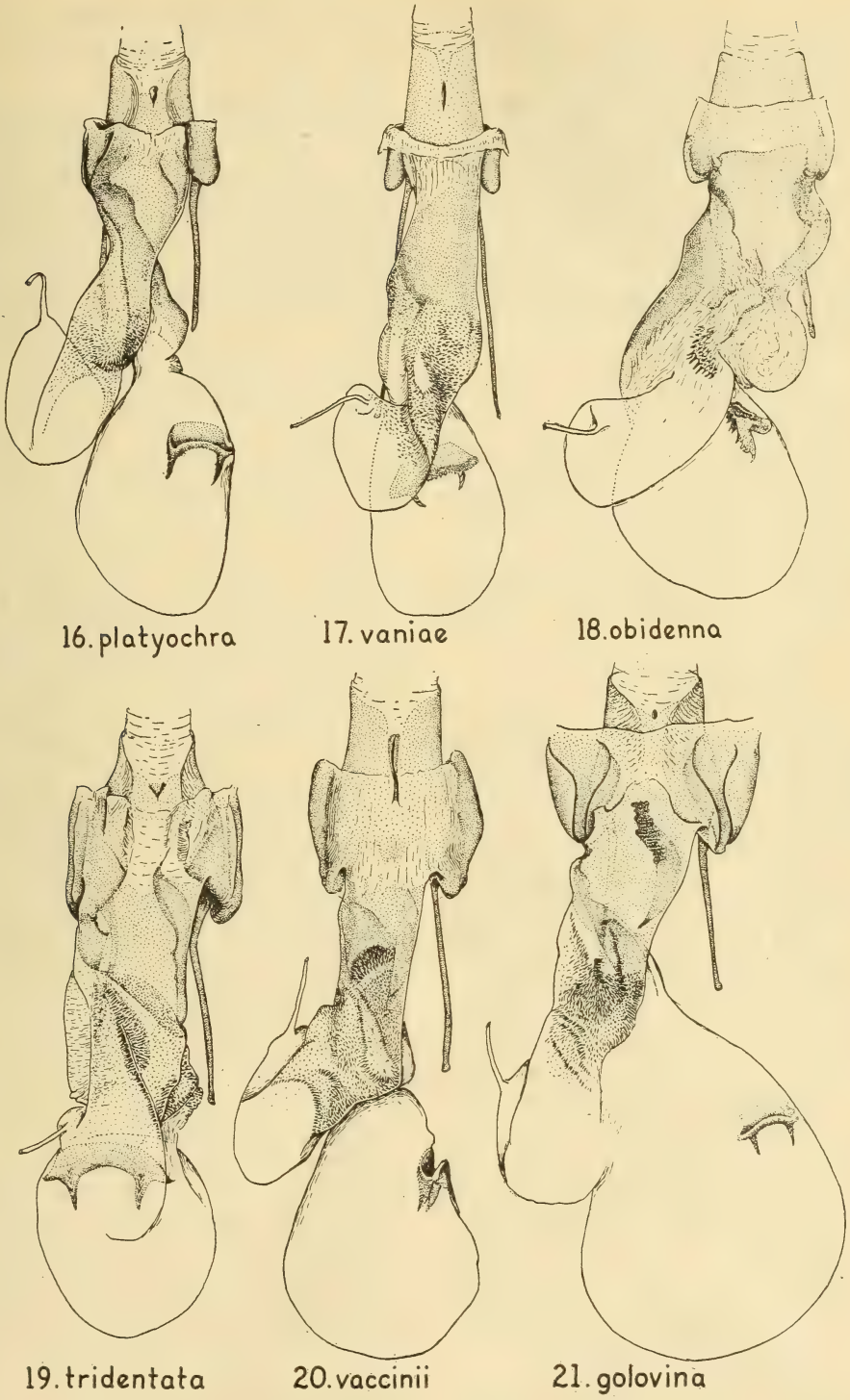
Gelechia frugalis Braun, Trans. Amer. Ent. Soc. **51**: 194. 1925.—Busck, Proc. U. S. Nat. Mus. **86**: 589. 1939.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America (part 2, Microlepidoptera), No. 8118. 1939.

Busck did not assign this species to its proper genus when he restricted the use of *Gelechia*. Dr. Braun has written, "The 'curtain scaling' is present in *frugalis* . . . ," and for this reason I assign it to *Filatima*. I have not studied the genitalia of *frugalis* and, therefore, cannot place it in its proper relationship to other members of the genus.

Filatima virgea, n. sp.
Figs. 10–10b, 13

Labial palpus gray inwardly on the second segment, sooty black in the brush and exteriorly; apex of the second segment white; third segment cinereous heavily overlaid with sooty black. Antenna blackish fuscous with indistinct gray annulations. Head, thorax, and forewing cinereous, the scales tipped with dark gray; along costa are scattered white scales; at apical fourth an ill-defined white fascia extends to tornus; in the cell, from middle of the wing to the end of cell, a conspicuous black dash turns at the end of cell and extends broadly, but less distinctly to tornus just inside the termination of the white fascia; from the outer end of the black dash an elongate patch of light sayal brown extends across the white transverse fascia; along costa and in fold are narrow, indistinct streaks of sayal brown; apex of wing purplish fuscous; cilia dark cinereous, irrorate with black. Hind wing gray basally shading to dark fuscous apically; cilia light fuscous; curtain scaling from the underside of costa, present in male. Legs creamy white strongly overlaid with sooty black. Abdomen above with first three segments sordid yellowish, remainder light fuscous; beneath creamy white irrorate and edged laterally with sooty black.

Male genitalia.—Almost symmetrical. Harpes



Figs. 16–21.—Female genitalia, ventral aspect, of: 16, *Filatima platyochra*, n. sp.; 17, *Filatima vaniae*, n. sp.; 18, *Filatima obidenna*, n. sp.; 19, *Filatima tridentata*, n. sp.; 20, *Filatima vaccinii*, n. sp.; 21, *Filatima golovina*, n. sp.

broad basally abruptly narrowed into a slender ventral lobe and a tenuis dorsal member. Uncus dilated posterodorsally and with a thin hood extending well forward over the tegumen. Gnathos a moderately stout hook with a few small teeth on the posteroventral edge. Aedeagus rather atypical with a peculiar slender extension from right side near middle (see Figs. 10–10b).

Female genitalia.—Normal for group except the signum has only one long curved, thornlike process instead of two.

Alar expanse, 15–18 mm.

Type.—U.S.N.M. no. 58258.

Type locality.—Presidio, Tex.

Food plant.—*Acacia vernicosa* Standl.

Remarks.—Described from the male type, one male and five female paratypes all from the type locality. All specimens bear the date 8-XI-1944 (emergence date ?) and were reared from larvae collected by J. H. Russell. Paratypes in the U. S. National Museum and the British Museum.

Filatima spinigera, n. sp.
Figs. 11–11b

Labial palpus creamy white; second segment narrowly pale fuscous exteriorly at base; third segment lightly and minutely irrorate with pale fuscous. Antenna fuscous. Head creamy white. Thorax and forewing sordid white to cinereous variously irrorate and marked with fuscous; costa, to apical third rather strongly, but narrowly, overlaid with fuscous; at apical third a poorly defined white spot is preceded by a small, fuscous blotch; around apex and along termen a row of indistinct, small fuscous spots is terminated, slightly before tornus, by an ill-defined, fuscous, outwardly oblique dash confluent with the discal spot at end of cell; in center of cell a small fuscous spot; both discal cell spots preceded and followed by light yellowish brown scales; cilia light yellowish fuscous irrorate with fuscous. Hind wing shining silvery white; cilia light yellowish fuscous; curtain scaling from underside of costa of male absent. Legs creamy white overlaid with fuscous. Abdomen sordid white lightly marked with fuscous beneath; anal tuft shining white.

Male genitalia.—Symmetrical. Dorsal lobe of harpe slender, short, tapering to a point and scarcely exceeding in length the thick fleshy ventral lobe. Aedeagus consisting of four stout, thornlike processes arising from a common base. Gnathos a short stout hook.

Alar expanse, 20–22 mm.

Type.—U.S.N.M. no. 58247.

Type locality.—Mojave Desert, near Llano, Calif.

Remarks.—Described from the male type and seven male paratypes from California as follows: Three paratypes from the type locality (4-IV-1938, Dr. John A. Comstock); one, La Puerta Valley (March 1); one, Dixieland, Imperial County (March 1–15, 1922, O. C. Poling); one, Essex (12-IV-1938) and one, Riverside (8-III-1934). The last two were collected by Grace H. and John L. Sperry.

Paratypes in the U. S. National Museum, the Los Angeles Museum, the British Museum, and in the collection of Grace H. and John L. Sperry, Riverside, Calif.

In the species group of the genus, to which *spinigera* belongs, are two other species, namely, *F. natalis* (Heinrich) and *F. inquilinella* (Busck). *F. spinigera* is nearest to *natalis* but can be distinguished from it by the short slender dorsal lobe of the harpe.

Filatima obidenna, n. sp.
Figs. 7–7b, 18

Labial palpus chalky white with blackish fuscous in the brush and completely overlaid with the same color exteriorly; third segment profusely irrorate with blackish fuscous. Head and thorax cinereous, the scales tipped with fuscous; face sordid white. Ground color of forewing dark fuscous; costal fourth of wing, from base to apical fourth, white with fuscous irrorations; extreme base of costa and two or three small spots within the white area near base, black; at basal fifth and middle the white costal color projects obliquely and transversely as incomplete fasciae to or slightly beyond fold; at apical fourth the white color extends across the wing totornus as an ill-defined transverse fascia; along the inner margin of the white costal area is irregular longitudinal olivaceous scaling; cilia pale fuscous with fuscous irrorations. Hind wing pale shining grayish fuscous basally shading to fuscous apically; cilia pale fuscous, darker apically; curtain scaling from underside of costa absent. Legs creamy white overlaid and banded with fuscous. Abdomen with first three segments yellowish above, remainder sor-

did whitish somewhat infuscated; beneath fuscous with a narrow irregular white central area.

Male genitalia.—Almost symmetrical. Ventral lobes of both harpes greatly reduced, dorsal members slender, pointed. Gnathos a long, slender curved process. Uncus slender, divided apically. Aedeagus with strongly sclerotized, spinous processes on the left side, and one thornlike process on the right side.

Female genitalia.—Signum with a single long dentate process.

Alar expanse, 17–20 mm.

Type.—U.S.N.M. no. 58252.

Type locality.—Paradise, Cochise County, Ariz.

Remarks.—Described from the male type, three male and four female paratypes from Arizona as follows: Paradise, Cochise County, four males, two females (April 1–7; no year or collector); Redington, two females (no further data). Paratypes in the U. S. National Museum and the British Museum.

Of the species described in this paper *obidenna* is nearest to *virgea*, but is probably more nearly related to *albicostella* Clarke.

Fascista bimaculella (Chambers), n. comb.

Gelechia bimaculella Chambers, Can. Ent. **4**: 108. 1872.
Gelechia (? *Lita*) *ternariella* Zeller, Verh. zool.-bot. Ges. Wien **23**: 264. 1873.
Gelechia sylvaecolella Chambers, U. S. Geol. Geogr. Surv. Terr. Bull. **4**: 86. 1878.
Filatima bimaculella (Chambers) Busck, Proc. U. S. Nat. Mus. **86**: 576. 1939.

Busck referred this species to *Filatima*, but a study of the genitalia reveals that *bimaculella* should be assigned to *Fascista*.

ICHTHYOLOGY.—*American species and subspecies of* Bathygobius, *with a demonstration of a suggested modified system of nomenclature.*[1]

ISAAC GINSBURG, U. S. Fish and Wildlife Service. (Communicated by ELMER HIGGINS.)

The chief aim of this paper is to characterize briefly the American species and subspecies of fishes belonging to the genus *Bathygobius* and formally establish the names for these categories. The conclusions here epitomized are based on a detailed study of samples of the American populations[2] comprising, in the aggregate, over 800 specimens. The data have been tabulated, and of the characters studied the main ones of those that have proved pertinent to a taxonomic division of the populations are here employed. Some of the most important characters here used were, either altogether or partly, not taken into account by previous authors. Characters determined in this study which proved to be of secondary importance, and size and sex differences in proportional measurements (which are sometimes considerable), are generally omitted in this preliminary, condensed account. The populations of *Bathygobius* are here classified in accordance with what seems to be the proper interpretation of the totality of my voluminous data. The names of the taxonomic categories here established will prove to be of much help in the further study of the populations, by the proper labeling of the considerable amount of permanently preserved museum material that has been studied, and their use in discussion and correspondence.

Bathygobius is in an early stage of speciation at the present time level. The divergence of the species is of a low degree of magnitude in general. The divergence of some of the closely related and immediately contrasting populations is near the borderline between species and subspecies, and they may be designated either as full species or as subspecies, depending on a subjective estimate made by a given author. Furthermore, the species and subspecies are more or less heterogeneous, sometimes markedly so. Every minor local population shows its distinctive frequency distribution in one or more characters. The divergences of the local populations are of different degrees of magnitude and it is difficult to draw a line between the subspecies and the next lower categories. As a consequence, the proper

[1] Received February 14, 1947.

[2] The term "population" is used throughout this paper in the sense previously defined by me (Copeia 1937 (3): 185). That is, it is a general convenient term used to cover any natural group of individuals of species rank or lower.

taxonomic treatment of *Bathygobius*, the distinction of the populations and their division into species and the minor intraspecific categories, is difficult. On the other hand, an intensive study of progressive stages in the differentiation and ramification of natural populations, which *Bathygobius* affords, from the almost initial to moderately advanced stages, should be of help in throwing light on the species problem and in the speculative contemplation of evolution, more so than the study of speciation in genera in which the species are easily distinguishable.

Bathygobius does not differ from other genera of gobies in showing any special kind of speciation. In other genera, also, it is often found that a section containing two or more species is in an early stage of speciation, and such species, like the species of *Bathygobius*, are difficult to distinguish. *Bathygobius* is exceptional in that all the species, at least the American species, are in an early stage of speciation.

The taxonomic treatment of *Bathygobius* hitherto presented by authors is inadequate, evidently because of the state of speciation existing in this genus and the difficulty of distinguishing the species. The usual descriptive methods used in taxonomic routine are of but little avail for an understanding of the state of speciation in *Bathygobius*. A proper study of variability, by the determination and constructive marshaling of mass numerical data, is indispensable.

There is no general agreement among taxonomists in the treatment of the genus. Without going into a detailed review of the literature, I may state that recently most authors recognize two species on the Atlantic and Pacific coasts of North and South America, including the West Indies, namely, one species, *curaçao*, confined to the western Atlantic and comparatively not common, and another species, *soporator*, common to abundant, and widely distributed on the Atlantic and Pacific coasts. However, *curaçao* is not recognized by all authors. Furthermore, some authors treat the common American populations which are designated *soporator* by most other authors, as belonging to one supposedly circumglobal species, *Bathygobius fuscus*. My detailed study of the genus shows that existing published ideas regarding species distinction in *Bathygobius* are either untenable or represent only a small part of the story, as the following pages will unfold.

As a result of this study four names that have generally been placed in the synonymy because the original authors failed to elaborate the real distinguishing characters of their species, namely, *arundelii*, *catulus*, *lineatus*, and *andrei*, are resurrected and applied to their respective populations.

In this preliminary paper it is possible to give only a very sketchy, skeletonized outline of the richness and diversity of differentiation among the American populations of *Bathygobius*. Moreover, a complete study of the genus should include also the numerous populations from Oceania, the eastern Atlantic, the Red Sea, etc. But samples of these extralimital populations are not well represented in American museums.

The given length of specimens refers to the total length, including the caudal fin. Figures for measurements refer to percentages of the standard length. They are abstracted from my manuscript tables and are given to the nearest whole or half number as in those tables. Except as otherwise indicated, measurements, including the mode where stated, are based on the combined data, irrespective of size and sex. When the measurements are segregated by size and sex (as in the manuscript tables), the averages, the ranges or the modes differ by these groupings in most cases; but these details are omitted for the present.

Incidental to the chief aim, as stated above, a secondary object of this paper is to demonstrate the use of a modification in the conventional system of zoological nomenclature, for species and their subdivisions, where such subdivision is taken cognizance of by the formal establishment of scientific names. This modification has been proposed by me in a previous publication (Zoologica **23**: 282–284. 1938). The present paper demonstrates how the proposed modification works in actual practice. The main headings for the subspecies are trinomials in compliance with the international code. The proposed modification is used as subheadings and in the discussions.

Discontent with the conventional system of nomenclature, or widespread current usage, especially for categories below that of species, has been evinced by biologists. This discontent rests on a more fundamental basis than the mere desire for change. Ideas referring to the basic species concept have been undergoing developmental changes, which have been especially rapid in recent years. The inevitable next step then, in discussing species, was to seek for a modification in zoological nomenclature which, in part, constitutes the language that expresses our ideas of the species concept. That is to say, there is a desire for a change in language in order to express more nearly our changed ideas.

Another cause of dissatisfaction is the use of quadrinomials, which in itself is a modification or extension of the existing international code. Quadrinomials smack too much of the pre-Linnaean polynomial system, in form though not in theory. Moreover, natural populations of species rank and lower, form, in miniature, a hierarchy of categories with a gradually decreasing magnitude of divergence, and there is no inherent reason to stop at quadrinomials. Some authors might propose to use quinquenomials or even sexinomials.

Still another urge for change is motivated by the desire for simplicity in nomenclature.

It is not my aim to give a comprehensive review and discussion of the various proposals that have been made for the modification of zoological nomenclature. A view that seems to have a considerable number of adherents has been expressed by Professor Needham (Science **71**: 26–28. 1930), namely, that if a population has reached a sufficient degree of divergence, as compared with immediately related populations, to be worth naming at all a binomial designation is enough. Reference to this proposition is also made by Professor Cole (Science **93**: 317. 1941). According to this view a name is primarily a handle, a convenient tool for its use in research and discussion of a given entity, which, after all, is the chief function of a name. As a tool, simplicity in nomenclature is desirable.

An argument often introduced for the use of trinomials and quadrinomials is that they also show relationship. However, it is not the function of nomenclature to show relationship. The system of nomenclature now in use does not show relationship at the species level and above (except in showing the generic affiliation of the species); it is not possible to devise a simple system that will do so. Moreover, the indication of relationship by a trinomial is limited; it does not show the relationship of the subspecies, of any one species, to one another. This argument also is not altogether applicable to borderline populations. A given borderline population may be treated by one author as a subspecies with the use of a trinomial and an indication, in a limited way, of relationship; while another author may treat the same population as a full species with the use of a binomial and no indication of relationship. Yet both hypothetical authors treat of the same entity. (It is safe to predict that the number of borderline cases will increase as taxonomists determine more and more the variability and morphologic ranges of the species they now recognize.) Also, suppose two of the intraspecific populations of a given species are near the borderline between subspecies and the next lower category (which I proposed to call "race" in the 1938 paper cited above). One author then may treat them as subspecies and use a trinomial without an indication of their near relationship, as compared with the other coordinate subspecies; while another author may treat them as races and use quadrinomials which would show their close relationship. (Theoretically, the same reasoning applies to quadrinomials and the next lower step in the hierarchy.) Finally, ideas of relationship change with increased knowledge, while nomenclature, to fulfill efficiently its chief function as a tool, should be fixed. To tie up nomenclature with ideas of relationship current for a time, as it is done by the use of trinomials, will lead, perhaps often, to changes of combinations of names.

The modification proposed by me and here demonstrated constitutes a sort of a synthesis of the method in current use and the view stated above which holds that all names should be binomial. The names used in my modification are universally binomial,

and when a species is formally split up into subspecies, a numeral subscript is added to indicate the taxonomic category of the population named. It is reasonable to expect that some changes in the prevailing system of zoological nomenclature will be gradually evolved and generally adopted some day. My suggested modification is here introduced, because *Bathygobius* constitutes a favorable example to demonstrate it. The suggested modification is presented for the consideration of biologists and to obtain their reaction. Perhaps it will form a basis for discussion. It is hoped that at least it will be found useful as supplementary to the conventional system for the sake of brevity in discussion.

Bathygobius curaçao (Metzlaar), **sensu lato**
Bathygobius curaçao$_1$ (Metzlaar)

Scales 31–36, present or absent on side of head. Pectoral rays usually 16–17, infrequently 15 or 18; upper 3 or 4 rays modified, their branching very sparse, nearly always forking once. Maxillary 11.5–13.5.

This species is synpatric[3] with *soporator$_1$* (except *catulus$_2$*) and *mystacium*. It differs from *soporator$_1$* chiefly in having a smaller number of scales and pectoral rays and fewer modified rays. From *mystacium* it differs mainly in having fewer pectoral rays and a longer maxillary. The samples examined by me are divisible into two subspecies as follows:

Bathygobius curaçao lepidopoma, n. subsp.
Bathygobius lepidopoma$_2$, n. subsp.

Opercle with a patch of 1–8 scales at upper anterior corner; a patch of scales on cheek in the majority of specimens (in about two-thirds). Pectoral 23–26.

[3] This apt term, effectively used by Mayr in a recent book, *Taxonomy and the origin of species*, which treats mainly of some aspects of tendencies and trends in ornithologic taxonomy, should prove useful for brevity and in clarifying taxonomic discussions in general, and deserves a wider application. Two populations are synpatric when their geographic ranges coincide or overlap; they are allopatric when they occupy separate territories. It so happens that closely related populations of a lower rank than full species are, as a rule, allopatric. This is a universal fact of biology and applies to fishes as well as to birds and other groups. Bearing this in mind should help to preclude fallacious interpretation of taxonomic data in ichthyology as well.

Holotype: U.S.N.M. no. 57452. Newfound Bay, Fla.; male 55 mm.

A composite sample of 10 other specimens 31–55 mm examined from Newfound Harbor, Broad Creek, Boca Chica, and Key West; all localities in southern Florida.

This subspecies differs from *curaçao$_2$* chiefly in the scalation on the side of the head. They differ in a lesser degree in some proportional measurements. Typical specimens have a distinctive physiognomy. On the whole, the difference between *curaçao$_2$* and *lepidopoma$_2$* is greater than the usual difference between two coordinate subspecies. It is rather near the borderline between species and subspecies, and it would not be far fetched to treat them as two allopatric species. *B. lepidopoma$_2$* evidently has a very restricted distribution, being confined to Key West and the very closely adjacent keys where it replaces *curaçao$_2$*. Samples from Tortugas agree more nearly with *curaçao$_2$* from the West Indies and Panama and are grouped with that subspecies.

Bathygobius curaçao curaçao (Metzlaar)
Bathygobius curaçao$_2$ (Metzlaar)

Gobius curaçao Metzlaar, Rap. Vissch. Kolonie Curaçao, edit. by J. Boeke, **2**: 136. 1919 (Curaçao; Bonaire).

Opercle usually without scales, variants sometimes having one or two scales; infrequently 2–3 scales on cheek. Pectoral 25–28.

A composite sample of 25 specimens 23–62 mm examined from Tortugas, Florida; Bermuda; Haiti; St. Thomas, Virgin Islands; Curaçao; Colon and Porto Bello, Panama.

Bathygobius mystacium, n. sp.

Scales 34–36, none on side of head. Pectoral rays 19–20; upper 4 or 5 modified, their branching sparse, usually forking once. Maxillary 9.5–11.5.

Holotype: U.S.N.M. no. 119895. Nassau, Bahamas; male 57 mm.

A composite sample of 8 other specimens 31–57 mm examined from Nassau, Bahamas; Cuba; Old Providence Island; Colon, Panama.

This species is synpatric with *curaçao$_2$*, *soporator$_2$*, and *longiceps$_2$*. Some specimens were found mixed in the same containers with *soporator$_2$*, and they evidently occur together. It differs from *soporator$_1$* in having fewer scales and from *curaçao$_1$* in having more pectoral

rays. It differs from both in having a shorter maxillary. It intergrades slightly with *curaçao*$_1$ in the latter character, but not with *soporator*$_1$ when the data are segregated by size.

Bathygobius arundelii (Garman)

Gobius arundelii Garman, Proc. New England Zool. Club **1**: 63. 1899 (Clipperton Island).

Scales 37; present on opercle in a small patch; a few also present on cheek. Pectoral rays 19 (probably only upper 3 modified and forking only once, the fin partly broken in the single specimen examined). Caudal 34 (the combined range of several hundred specimens of all other American species 23–33).

Only the type specimen of this species was examined. It is difficult to discuss the relationship of any one species of *Bathygobius* on the basis of a single specimen, because all the species are so near one another morphologically. For instance, the scale count of this specimen is at the borderline of the separation of two groups of species, and to have an adequate picture of the position of *arundelii* it is necessary to determine the frequency distribution of its scale count. However, after determining the morphological ranges of the other species on the basis of more or less adequate samples, it becomes clear that the single type specimen represents a species, *arundelii*, which is different than all other American species. It differs from *mystacium*, *soporator*$_1$, *ramosus*$_1$, and *lineatus*$_1$ in having scales on the side of the head. It differs from *curaçao*$_1$ in having more, and from *andrei*$_1$ in having fewer pectoral rays. It apparently differs further from *andrei*$_1$ in having fewer modified rays. It seems to differ from all American species in having a longer caudal. It is quite likely an insular species confined to Clipperton Island.

Bathygobius soporator (Cuvier and Valenciennes), **sensu lato**
Bathygobius soporator$_1$ (Cuvier and Valenciennes)

Scales 37–42, absent on side of head. Pectoral rays 17–22; upper 4–6 rays modified, their extent of branching moderate, the upper three usually forking but once. Ventral (measurement of longest rays from their point of articulation) 20–26 in 91 per cent of specimens, lower limit of range 18. Posterior dorsal rays of large male prolonged, reaching end of hypural or a little beyond. Color pattern very variable and its norm differing also with the local population; a rather diffuse, incomplete and irregular cross-banded pattern; or superimposed on cross-banded pattern, partly or almost wholly replacing it, a 2-rowed spotted pattern on lower half of body, two longitudinal rows of spots, one row of about 9 spots running full length of body directly below the midline, and a shorter row under anterior part of upper row. Maxillary 11.5–16.5.

This species is nearest morphologically to *mystacium*, *lineatus*$_1$, and *ramosus*$_1$ and the differences between *soporator*$_1$ and those three species are discussed briefly under their accounts.

This species is markedly heterogeneous. Moreover, morphologic divergence of the different populations is correlated with geographic distribution only in a very general way; the two do not always coincide. Hence, it is difficult to draw a line between the subspecies and the next lower category or race. On the basis of the samples examined, considering morphology as the primary and geography as a secondary factor in reaching conclusions, the species is divided into four subspecies. As here constituted, *catulus*$_2$ and *soporator*$_2$ are more heterogeneous than the other two, *soporator*$_2$ especially so. Some of the populations grouped under *soporator*$_2$, perhaps also some placed under *catulus*$_2$, might be raised to subspecies rank after a study of more extensive samples.

Bathygobius soporator catulus (Girard)
Bathygobius catulus$_2$ (Girard)

Gobius catulus Girard, Proc. Acad. Nat. Sci. Philadelphia 1858: 169 (St. Joseph Island, Tex.).

Head modally 31, varying 29–33. Caudal 25–28 in 90 per cent of specimens, varying 24–30. Eye 6.5–8.0 in specimen 61–80 mm. Postorbital 15–18. Pectoral rays 17–20; the number of modified rays usually 4. Color pattern of the cross-banded phase; on lower half of body pigment sometimes diffusely separated, presenting a rather faint suggestion of the two-rowed spotted pattern, especially in small specimens.

A composite sample of 70 specimens 20–126 mm, examined from the East and Gulf coasts of the United States ranging from Pilot Town to New Smyrna, Fla., and from Indian Key (at Ten Thousand Islands), Fla., to Corpus Christi Pass, Tex. A small composite sample from the southernmost Florida Keys is tentatively included below under *soporator*$_2$.

This subspecies is characterized by averaging a short caudal, small eye and a low pectoral count, besides other differences, as compared with the other populations of *soporator*$_1$.

Bathygobius soporator soporator (Cuvier and Valenciennes)
Bathygobius soporator$_2$ (Cuvier and Valenciennes)

Gobius soporator Cuvier and Valenciennes, Hist. Nat. Poiss. **12**: 56. 1837 (Martinique; Cuba).

Head usually 30–32, varying 28–34. Caudal 26–30 in 90 per cent of specimens, varying 25–33. Eye 6.5–9.5 in specimens 61–80 mm. Postorbital 15–18. Antedorsal 34–42. Maxillary modally 13.5 or 14.5, depending on the population. Pectoral rays 18–21 with the mode at 19 or 20 depending on the population; number of modified rays usually 5; fourth modified ray (from top) forking more than once in about 50 per cent of specimens of most populations. The 2-rowed, spotted pattern rather well-defined in most populations; while in some others the cross-banded or an intermediate pattern is common.

A composite sample of 200 specimens 14–122 mm examined. Composite samples of 12 specimens or more were examined from the Bahamas, Cuba, Santo Domingo, Puerto Rico and Brazil. Smaller samples examined from Martinique (one of the type localities) and Cozumel Island, Mexico, are grouped with this subspecies. Samples of 1–6 specimens examined from localities in between those mentioned are also included, except a large sample from Panama, which is next described as a distinct subspecies. A small composite sample of 16 specimens 39–112 mm from the southernmost Florida Keys, namely, Lower Matecumbe Key, Key West, and Tortugas, is not decisive, but is perhaps slightly nearer *soporator*$_2$ than *catulus*$_2$ and is tentatively grouped with this subspecies.

Bathygobius soporator longiceps, n. subsp.
Bathygobius longiceps$_2$, n. subsp.

Head modally 32, varying 29–34. Caudal 26–29 in 90 per cent of specimens, varying 25–30. Eye 7–9 in specimens 61–80 mm. Postorbital 15–20. Antedorsal 36–43. Maxillary modally 14.5. Pectoral rays 18–21 with the mode at 19; the number of modified rays usually 5; the fourth modified ray forking once in about 80 per cent of specimens. Color pattern variable; cross-banded, two-row spotted, or intermediate.

Holotype: U.S.N.M. no. 119896. Porto Bello, Panama; male 108 mm.

A composite sample of 90 other specimens 17–88 mm examined from various localities on the Atlantic coast of Panama and the Canal Zone.

The Panama population is separated as a distinct subspecies from the other populations of *soporator*$_2$ largely on the basis of a combination of characters. It has a comparatively long head, postorbital, antedorsal and maxillary, a comparatively low pectoral count and sparse extent of branching of the modified pectoral rays. These characters are nearly duplicated in one or another of the populations of the heterogeneous *soporator*$_2$; but in the Panama population they occur together, and for this reason it is deemed appropriate to set it aside as a distinct subspecies, *longiceps*$_2$.

Bathygobius sporator sextaneus, n. subsp.
Bathygobius sextaneus$_2$, n. subsp.

Head 28–32. Caudal 26–32. Eye 7–9 in specimens 65–80 mm. Postorbital 14–16. Antedorsal 35–38. Maxillary 12.5–14.5. Pectoral rays 19–22 with the mode at 20; the number of modified rays usually 6. Two-rowed, spotted color pattern usually rather well defined.

Holotype: U.S.N.M. no. 21231. Bermuda; female 103 mm.

A composite sample of 18 other specimens 44–113 mm examined from Bermuda.

This subspecies differs from the others in usually having 6 modified rays and averaging a higher pectoral count. The sixth ray of *sextaneus*$_2$ resembles in structure the fifth ray (or the fourth) of the other subspecies. The postorbital part of the head especially, and also the head, antedorsal distance and maxillary are short.

Bathygobius lineatus (Jenyns), **sensu lato**
Bathygobius lineatus$_1$ (Jenyns)

Scales 38–42, none on side of head. Pectoral rays 19–22; usually upper 5 rays modified, their extent of branching rather sparse, the upper 3 usually forking once. Large male with the posterior dorsal rays not notably prolonged, not reaching end of hypural.

This species is divisible into two subspecies, *lineatus*$_2$ in the Galápagos Islands and *lupinus*$_2$

from Lobos de Afuera Island, off the coast of Peru.

B. lineatus$_1$ is another borderline population morphologically. It is very close to *soporator*$_1$, and its two subspecies might within reason be placed as subspecies of *soporator*$_1$. It differs from *soporator*$_1$ chiefly in the relative length of the posterior dorsal rays of the large male. But even this character is not pronounced, and moreover, it differs to a moderate extent also intraspecifically with the local populations. However, because of the absolute geographic separation of *lineatus*$_1$ and *soporator*$_1$ and for convenience, it is deemed best to treat them as two full species based on this one rather slight and variable difference. As the species of *Bathygobius*, in general, have not yet diverged to a high degree, this small difference perhaps takes on added significance.

Bathygobius lineatus lineatus (Jenyns)
Bathygobius lineatus$_2$ (Jenyns)

Gobius lineatus Jenyns, Zool. Voy. *Beagle* **4**: 95, pl. 19, fig. 2. 1842 (Galápagos).

Depth of caudal peduncle 11.5–14.5. Head 29–34. Postorbital 14–18. Antedorsal 35–41. Maxillary 12.5–15.5 in specimens 56–94 mm. Pectoral rays 19–22, with the mode at 20.

Of this subspecies 70 specimens 17–94 mm were examined from James, Chatham, Charles, Bartholomieu, and Narborough Islands. It is evidently an insular subspecies of the Galápagos Archipelago.

Bathygobius lineatus lupinus, n. subsp.
Bathygobius lupinus$_2$, n. subsp.

Depth of caudal peduncle 14.5–15.5. Head 29–30. Postorbital 14–15. Antedorsal 35–37. Maxillary 12.5–14.5 in specimens 66–123 mm. Pectoral rays 19–20.

Holotype: U.S.N.M. no. 77510. Lobos de Afuera, Peru; male 123 mm.

Two other males 66–85 mm examined from the same place.

This subspecies differs from *lineatus*$_2$ in averaging a deeper peduncle and a shorter head, postorbital, antedorsal and maxillary. It attains to a larger size. While ordinarily it is a risky business to establish a new subspecies on the basis of only 3 specimens, yet, after comparing the measurements of these specimens with the frequency distribution of *lineatus*$_2$, and other species and subspecies of *Bathygobius*, I am confident that an examination of an adequate sample from Peru will confirm the conclusion that that population is subspecifically distinct from that of the Galápagos.

Bathygobius ramosus, n. sp., **sensu lato**
Bathygobius ramosus$_1$, n. sp.

Scales 36–43, none on side of head. Pectoral rays 17–21; usually the upper 5 modified, profusely branched, the second and third (from top) usually forking twice or three times. Ventral 15–19 in 88 per cent of the specimens, the upper limit of the range 22. Usually a single longitudinal row of about 9 spots nearly median in position; the spots, or a variable number of them, usually partly or almost wholly split up into 2 or 3 parts, presenting gross appearance of a series of more numerous and smaller spots than in *soporator*$_1$; cross-banded pattern absent or present on upper half of side only.

This is the commonest and most widespread species of *Bathygobius* on the Pacific coast of the American continents. All authors combined *ramosus*$_1$ with the common Atlantic *soporator*$_1$ under one heading. However, *ramosus*$_1$ differs from *soporator*$_1$ in having a shorter ventral, the modified pectoral rays branch more profusely and the color pattern is usually distinctive. Having examined in detail over 600 specimens of both species, I can safely make the statement that after one becomes familiar with their distinguishing characters and then attempts to identify single specimens, from the opposite coasts of Panama, without a knowledge of the locality of capture, he should make a correct identification in 95 or more trials out of 100. The large majority of specimens of *ramosus*$_1$ may be placed at a glance by distinctive color alone. This is about as good or better than is possible to do with many other closely related species which are generally recognized by authors.

The extent of branching of the modified pectoral rays varies greatly with the individual and each ray varies independently and in this preliminary paper the statements in the diagnoses of the two species give only a part of the picture of this difference.

The samples examined of *ramosus*$_1$ indicate that it is divisible in at least 4 subspecies, as follows:

Bathygobius ramosus curticeps, n. subsp.
Bathygobius curticeps$_2$, n. subsp.

Pectoral rays modally 20, varying 19–21.

Scales modally 39, varying 38–42 (infrequently 42). Head usually 29–30, varying 28–32. Caudal 25–31. Eye 7.5–9.0 in specimens 46–60 mm.

Holotype: U.S.N.M. no. 30739. Cape San Lucas, Mexico; male 98 mm.

A composite sample of 50 other specimens 23–92 mm examined from Cape San Lucas, Mazatlán, and Tres Marías Islands, all localities on the Pacific coast of Mexico. A small composite sample of 16 specimens 19–86 mm from Ecuador and Colombia agrees most nearly with *curticeps*$_2$ and is tentatively grouped with it.

This subspecies differs from *ramosus*$_2$ chiefly in having a shorter head and also in having a shorter postorbital, antedorsal and maxillary, and a somewhat less profuse branching of the modified pectoral rays.

Bathygobius ramosus ramosus, n. subsp.
Bathygobius ramosus$_2$**,** n. subsp.

Pectoral rays modally 20, varying 18–21 (infrequently 18). Scales modally 39, nearly always 37–41, rarely 36 or 42. Head usually 31–32, varying 29–33. Caudal 24–30. Eye 7.0–10.0 in specimens 46–60 mm.

Holotype: U.S.N.M. no. 119897. Balboa, Panama; male 87 mm.

A composite sample of 150 other specimens 21–101 mm examined in detail from various localities on the Pacific coast of Panama and the Canal Zone.

This subspecies is probably nearest *curticeps*$_2$ and their differences are stated above.

Bathygobius ramosus micromma, n. subsp.
Bathygobius micromma$_2$**,** n. subsp.

Pectoral rays usually 20, often 19. Scales 40–43. Head modally 29, varying 28–30. Caudal 26–28. Eye 6.5–7.5 in specimens 50–60 mm.

Holotype: U.S.N.M. no. 53504. Paita, Peru; male 61 mm.

Other 10 specimens 50–72 mm from same locality examined.

This subspecies averages the smallest eye and the highest scale count as compared with all other three subspecies. The head length is nearest to that of *curticeps*$_2$ (averaging somewhat shorter than in that subspecies even), and on the whole, it is nearest morphologically to *curticeps*$_2$.

Bathygobius ramosus longipinnis, n. subsp.
Bathygobius longipinnis$_2$**,** n. subsp.

Pectoral rays modally 19, varying 17–20. Scales 38–41. Head modally 30, varying 28–32. Caudal 27–33. Eye 7.5–9.5 in specimens 46–56 mm.

Holotype: U.S.N.M. no. 119898. Socorro Island, Revillagigedo Archipelago; male 78 mm.

A composite sample of 25 other specimens 15–90 mm examined from same island.

This is evidently an insular subspecies inhabiting Socorro Island (perhaps also the other islands in the Revillagigedo Archipelago). It differs from the other three subspecies in having a lower pectoral count and a longer caudal. The other fins also average somewhat longer but the divergence is not as marked. On the whole, *longipinnis*$_2$ diverges from the three mainland species to a greater extent than the latter diverge from one another. Its divergence is not far from the borderline of species and subspecies.

Bathygobius andrei (Sauvage), **sensu lato**
Bathygobius andrei$_1$ (Sauvage)

Scales 37–42, present or absent on side of head. Pectoral rays usually 21–22, varying 20–23; usually upper 5 rays modified, moderately branched, the upper three usually forking once. An incomplete and diffuse cross-banded color pattern.

This species is divisible into two synpatric subspecies, the distributional basis of their separation probably being water depth as indicated below, that is, they are apparently two synpatric ecological subspecies.

One subspecies, *andrei*$_2$, is readily separated from *ramosus*$_1$, *soporator*$_1$, and *lineatus*$_1$ by having scales on the side of the head; but this does not always hold for the other subspecies. This species is further separable from *ramosus*$_1$, with which it is synpatric, by the extent of branching of the modified pectoral rays and the color pattern. The frequency distribution of the pectoral count is decidedly different in *andrei*$_1$ than in all other American species, but there is some overlapping in that character.

There is a shade of doubt in my mind whether the name *andrei*, which has been generally relegated to the synonymy, is properly applicable to the species here distinguished. Sauvage's original description is largely generic.

Moreover, that author states "tête entièrement nue," which does not apply to the main character that distinguishes our *andrei*$_2$. My reliance for the present use of the name *andrei* is based on the locality (Ecuador) and size (160 mm) given in the original description. According to my rather extensive samples that size is applicable only to that American population here designated *andrei*$_2$. I assume that Sauvage overlooked the patch of scales on the opercle.

Bathygobius andrei andrei (Sauvage)
Bathygobius andrei$_2$ (Sauvage)

Gobius andrei Sauvage, Bull. Soc. Philomatique (7) **4**: 44. 1880 (Guayas, Ecuador; in brackish water).

Scales 37–41; a rather large or moderate patch of scales on opercle; scales on cheek present or absent. Pectoral 22–29. Caudal 25–32. Head 30–35. Depth of peduncle 12.5–15.5.

A composite sample of 45 specimens 21–198 mm examined from the Pacific coast, ranging from Barranca, Costa Rica, to Guayaquil, Ecuador, and including Panama.

This is apparently a typical tide-pool population. It occurs together with *ramosus*$_2$ and some of the constituent samples examined were separated from containers which included a mixture of both that is readily separable into their proper species. *B. andrei*$_2$ constitutes a morphologically compact population rather easily separable (in a comparative way) from all American species and subspecies of *Bathygobius*, except *heteropoma*$_2$. The latter introduces a rather discordant element in the easy and orderly taxonomic placement of *andrei*$_2$. The proper distinction of *andrei*$_2$ from the other species is discussed above under *andrei*$_1$, and from *heteropoma*$_2$ under that subspecies below.

Bathygobius andrei heteropoma, n. subsp.
Bathygobius heteropoma$_2$, n. subsp.

Scales 40–42; absent on side of head, or when present, varying from a single scale to a small patch on opercle (smaller than in *andrei*$_2$). Pectoral 20–23. Caudal 23–28. Head 30–32. Depth of peduncle 14.5–15.5.

Holotype: U.S.N.M. no. 119894. Chame Point, Panama; male 101 mm; Robert Tweedlie.

A composite sample of 8 other specimens 47–115 mm examined from the same locality by the same collector.

Robert Tweedlie's collecting methods have been described by Meek and Hildebrand (Publ. Field Mus. Nat. Hist. **15** (1): 6. 1923), and it seems very probable that the specimens examined belong to a population that lives at a moderate distance offshore, while *andrei*$_2$ is a typical shore and tide-pool subspecies.

This subspecies differs from *andrei*$_2$ in lacking scales on side of the head, or when present they are in sparser numbers. (One is tempted to say that *heteropoma*$_2$ is on the way to losing the scalation on the side of the head because of its changed habitat.) The frequency distribution of the scale count will perhaps prove to differ in the two subspecies on further sampling. The caudal, head, postorbital, and antedorsal of *heteropoma*$_2$ seem to average shorter and the peduncle deeper than in *andrei*$_2$. The pectoral averages considerably shorter in *heteropoma*$_2$ than in *andrei*$_2$ and all other American species and subspecies of *Bathygobius*. Considering all differences, it may perhaps be stated that *heteropoma*$_2$ is not far from the borderline between species and subspecies.

KEY TO THE AMERICAN SPECIES AND SUBSPECIES OF *BATHYGOBIUS*[4]

a. Scales 31–36. Western Atlantic.
b. Pectoral rays 15–18 ..... *curaçao*$_1$
c. A patch of scales present on opercle. Key West and very closely adjacent keys.... *lepidopoma*$_2$
cc. Scales usually absent on opercle. Tortugas, Florida; West Indies; Panama..... *curaçao*$_2$
bb. Pectoral rays 19–20. West Indies; Panama..... *mystacium*
aa. Scales 36–43.
d. Pectoral rays 17–22, the mode at 18, 19, and 20, depending on the population.
e. Scales present on side of head; caudal 34. Clipperton Island..... *arundelii*
ee. Scales absent on side of head; caudal 23–33.
f. Upper three modified pectoral rays usually forking once; ventral 18–26.
g. Posterior dorsal rays of large male more or less prolonged, reaching end of hypural or a little beyond. Western Atlantic..... *soporator*$_1$
h. Modified pectoral rays usually 4 or 5.

[4] Footnote 4 at end of key (p. 284).

i. Caudal short and eye small. Florida to Texas, except southernmost Florida Keys. *catulus*$_2$

ii. Caudal longer and eye larger.

j. Head, postorbital, antedorsal, and maxillary long; pectoral count comparatively low; branching of modified rays sparse. Panama. *longiceps*$_2$

jj. Characters differing with the local population, but not occurring in preceding combination. Southernmost Florida keys to Brazil and the West Indies, excepting Panama. *soporator*$_2$

hh. Modified pectoral rays usually 6. Bermuda. *sextaneus*$_2$

gg. Posterior dorsal rays of large male not markedly prolonged, not reaching end of hypural. Eastern Pacific. *lineatus*$_1$

k. Depth of caudal peduncle 11.5–14.5; maximum length 94 mm. Galápagos Archipelago. *lineatus*$_2$

kk. Depth of caudal peduncle 14.5–15.5; maximum length 123 mm. Lobos de Afuera Island, Peru. *lupinus*$_2$

ff. Second and third modified pectoral rays usually forking more than once; ventral 15–22. Eastern Pacific. *ramosus*$_1$

l. Pectoral rays modally 20.

m. Eye not small; scales 36–42.

n. Head usually 29–30. Coasts of Mexico, Colombia, and Ecuador. *curticeps*$_2$

nn. Head usually 31–32. Panama. *ramosus*$_2$

mm. Eye small; scales 40–43. Paita, Peru. *micromma*$_2$

ll. Pectoral rays modally 19. Socorro Island. *longipinnis*$_2$

dd. Pectoral rays usually 21–22, varying 20–23. Eastern Pacific. *andrei*$_1$

o. Scales on opercle in a rather large or medium sized patch; pectoral 22–29. Costa Rica to Ecuador, including Panama, inshore. *andrei*$_2$

oo. Scales on opercle in a small patch or absent; pectoral 20–23. Panama, offshore. *heteropoma*$_2$

[4] I present this key here, in conjunction with the present short résumé, with some measure of reluctance, rather in deference to the opinion of many taxonomists who seem to regard a key as indispensable. In general, a key is, of course, a useful tool in taxonomic practice, when based on carefully tested data instead of being merely compiled from the literature. Even so, there are many exceptions, where the brief and categorical statements used in a key, without numerous qualifying phrases, and without reference to the full data in the text on which conclusions are based, may be somewhat misleading, and *Bathygobius* is such an exception. In such cases the key best finds its place in a publication presenting the full details of the study, reenforced by tables, instead of in a short, condensed, skeletonized, preliminary paper, such as this one. While this key gives a bird's-eye general view of the characters that separate, and the relationship between, the species and subspecies, the student should not assume that it constitutes an easy shortcut to enable him always to "run down" specimens correctly.

ZOOLOGY.—*Notes on some Mexican urocoptid mollusks, with the description of new species.*[1] Paul Bartsch, U. S. National Museum.

The U. S. National Museum recently received several sendings of mollusks from Mexico from that indefatigable collector, Miss Marie E. Bourgeois. Among other things these include fine lots of members belonging to the family Urocoptidae. Some of them have required considerable research to untangle the confused nomenclature, while others prove to belong to undescribed species. It is hoped that this little paper will prove helpful and stimulate our Mexican friends to further efforts in this field.

Genus **Anisospira** Strebel

Anisospira? martensii (Strebel)

1865. *Cylindrella* (*Urocoptis*) *truncata* von Martens, Malakoz. Blätt. **12**: 13–14, in part.

1880. *Eucalodium martensi* Strebel, Beitr. Kenntn. Fauna Mex. Land- und Süsswasser Conch. **4**: 73–74, in part; pl. 13, fig. 13; pl. 11, figs. 8, 14; pl. 12, fig. 3.

1897. *Eucalodium truncatum* von Martens, Biologia Centrali-Americana: 264, in part.

Shell decollated, turrited, solid, dusky olivaceous, somewhat paler at the suture; whorls remaining 7, scarcely convex, increasing regularly arcuately striate, with 3 or 4 slightly elevated, irregular spiral lines. Last whorl not solute, rounded, with an obsolete basal carina. Aperture subdiagonal, subcircular, posterior angle rounded, separated a little from the penultimate whorl. Columellar fold obsolete. Peristome somewhat thickened and slightly expanded. Length, 29.5 mm; diameter, 10 mm; aperture length, 7 mm; diameter, 6 mm.

[1] Received March 5, 1947.

The above is a translation of von Martens's Latin description of a specimen in the Berlin Museum collected by H. Uhde in Mexico. No specific locality was known for it.

Strebel (*loc. cit.*) redescribes this specimen as follows: The shell is solid and possesses the characters of *Eucalodium* as well as their form, coloration, and gloss. Its color is yellowish brown shading to paler and almost straw yellow in the suture. The sculpture consists of very inconspicuous, fine ribs, which are quite regularly but not closely spaced. In addition, one finds in places on the lower half of the whorls near the suture a short, irregular folding, which passes obliquely forward, and 2 to 4 fine, in places interrupted, weak, tumid, spiral lines, which are of the same strength and elevation as the axial ribs. It is difficult to say whether these features are individual or specific variations, but probably they are specific. The 7½ remaining whorls are well rounded, appressed at the summit, and slightly tumid at the suture, so that this appears slightly channeled. The last whorl in the beginning is weakly keeled below, then provided with a weak tumid area, which extends to the aperture. The specimen appears to be not quite adult, for the last portion seems to be on the point of becoming solute and the white peristome is only slightly expanded and not completely separated, although united by a columellar callus. The inside of the aperture is white with a faint violet tinge. The columella is simple, apparently hollow as in *Eucalodium* and twisted in each whorl about the axis. The columellar fold is slight and evenly placed. Height, 29.2 mm; diameter at tip, 6.4 mm; greatest diameter 9.8 mm; below 9.2 mm. Aperture height 7.7 mm; diameter, 6.5 mm.

This description is followed by a description of the dried soft parts, which von Martens found in the shell, which he figures on plate 11, figure 8 (radula), figure 14 (jaw), plate 12, figure 3 (reproductive system).

From Strebel's description I am led to believe that this shell belongs to the genus *Anisospira.*

Attempting to discover its possible home by tracing Uhde's peregrinations in Mexico, one finds the following information in Dr. Eduard von Martens's paper, "Ueber die mexikanischen Binnen Conchylien aus den Sammlungen von Deppe und Uhde in Berliner Museum."[2] Von Martens states that Uhde was a member of the Prussian Embassy staff in Mexico. Von Martens, under each species, lists the shells collected by Uhde. Many of these bear only "Mexico" as locality designation. A great number, however, give more specific locality data, showing that Uhde collected in the states of Veracruz, Puebla, Mexico, Oaxaca, and Michoacán. Since Oaxaca is the center of *Anisospira* distribution, it seems indicated that we should look for the home of this species in that state. Oaxaca is the home of *Anisospira dalli* von Martens, *liebmanni* Pfeiffer, *strebeli* Pfeiffer, *verdensis* Dall, and *orcutti* Dall. According to von Martens, Uhde collected "*Glandina turris* Pfeiffer" in Oaxaca near the west coast, at an elevation of 10,000 feet; also "*Helix bicincta* Pfeiffer" in the southern interior of Oaxaca and "*Bulimulus* (*Liostracus*) *mexicanus gracilior* Pfeiffer" in Oaxaca.

[2] Malakoz. Blätt. **12**: 1–78. 1865.

Genus **Oligostylus** Dall

Oligostylus mariae, n. sp. Fig. 1

1892. *Eucalodium martensi* (Strebel) Pilsbry, Man. Conch. **15**: 18–19, in part.

1897. *Eucalodium truncatum* (Pfeiffer) von Martens, Biologia Centrali-Americana: 256, 264, ?pl. 16, figs. 3–9.

Shell cylindroconic, chestnut-brown, with the peristome white with a brownish flush, interior of the aperture brownish. The early whorls are decollated. Even the young specimens bear the sculpture of the adult and have practically the same rotundity of the whorls. The adult shell has the whorls moderately rounded and separated by a well-impressed suture. They are crossed by numerous retractively slanting axial riblets, which are separated by spaces about as wide or a trifle wider than the riblets. Of these riblets, 96 are present on the last whorl, where they become more crowded immediately behind the peristome; 87 of them are present on the penultimate whorl. Periphery of the last whorl well rounded, with the merest indication of an angulation. Base short, well rounded, with a narrow umbilical chink and marked by the continuation of the axial ribs, which extend slightly enfeebled to the umbilical chink. The last whorl is slightly solute. Aperture broadly ovate, almost subcircular, and slightly oblique. Peristome slightly expanded, slightly reflected, and somewhat thickened. The columella shows an oblique fold deep within the aperture. The columella is

slender with the merest indication of a twist and without fold.

The type, U.S.N.M. no. 543582, was collected by Miss Bourgeois at Omiltemi, Guerrero. It bas 7 whorls remaining and measures: Length, 26.3 mm; greatest diameter, 8.9 mm. U.S.N.M. no. 543583 and U.S.N.M. no. 543584 contain 21 young and adult topotypes from the same source. Five additional specimens have been returned to Miss Bourgeois. These bear the collector's numbers 990 and 991.

The species is probably most nearly related to *Eucalodium neglectum* Crosse and Fischer, described from Oaxaca, Mexico. This, however, is much larger with quite different sculpture.

Von Martens states, on page 264 under the much confused concept of *Eucalodium truncatum*, that he has received several specimens from H. H. Smith collected at "Omilteme," Guerrero, which enables him to give a new description and figure of it. Apparently there must have been an error in his citation, for his explanation of figures on plate 16, figures 3 to 9, are all credited to Angangueo (Michoacán). They were probably based on the Omiltemi specimens.

Oligostylus? hegewischi, n. name

1841. *Bulimus truncatus* Pfeiffer, Symb. Hist. Helic.: 43–44, not *Bulimus truncatus* Bruguière, Encycl. Method.: 319, 1792.
1843. *Bulimus truncatus* Pfeiffer, Philippi Abbild. Beschr. Conch.: 55, pl. 1, figs. 8a, b, c.
1848. *Bulimus truncatus* Pfeiffer, Monogr. Helic. Viv. **2:** 154.
1849. *Bulimus truncatus* Reeve, Conch. Icon.: pl. 70, fig. 498.
1865. *Cylindrella* (*Urocoptis*) *truncata* von Martens, Malakoz. Blätt. **12:** 13–14, in part.
1873. *Eucalodium truncatum* Fischer and Crosse, Miss. Scient. Mex., Mollusca, **1:** 392–394, in part.
1886. *Eucalodium martensii* Strebel, Beitr. Kenntn. Fauna Mex. Land- und Süsswasser Conch. **4:** 73–74, in part.
1897. *Eucalodium truncatum* von Martens, Biologia Centrali-Americana: 265, in part.
1902. *Eucalodium martensi* Pilsbry, Man. Conch. **15:** 18–19, in part.

Shell subcylindric, apex decollated, solid, epidermis greenish horn-colored, obliquely striate; suture impressed, pale; whorls 8, convex, the last angulated at base; aperture suborbicular, soiled white within; peristome almost simple, almost covering the slight umbilicus rimation with its expanded columellar edge. Length, 14 lines [30.5 mm]; diameter, $4\frac{1}{3}$ lines [9.4 mm].

Near Angangueo, Michoacán, Mexico, collected by Hegewisch under leaves of American agaves.

The above is a translation of Pfeiffer's Latin description to which he adds, in Philippi, page 55, that he had in addition to the adult specimen, some young individuals one of which is also figured in c. He states here that the whole shell is quite regularly obliquely striated, brownish, tending toward olive-green, with every turn much paler toward the suture.

Pfeiffer states in a footnote in von Martens's paper (Malakoz. Blätt. **12:** 14) that he had to return to Hegewisch the adult specimen and that it is unknown what has become of this. All of which means that the proper systematic position of *Bulimus truncatus* Pfeiffer, which I am here rechristening *Oligostylus hegewischi*, will have to await the securing of specimens from the type locality.

It is to be hoped that Miss Bourgeois will rediscover it at Angangueo.

Genus **Coelocentrum** Crosse and Fischer

Coelocentrum huertai, n. sp.

Fig. 5

Shell cylindroconic, chestnut-brown (sometimes white), with the aperture brown or in the albinos white. The nuclear whorls are decollated in all our specimens. Young shells minus the extreme nuclear tip show that the shell increases quite regularly in size, but the outlines thereof are slightly concave until the last decollated stage is reached. From there they increase slightly in size to the middle of the spire and then again slightly decrease toward the last whorl. The whorls are slightly rounded and separated by a well-impressed suture. They are crossed by numerous very fine, hairlike, closely spaced, retractively curved axial riblets, which are about as wide as the spaces that separate them. Of these riblets, 193 are present on the penultimate whorl of the type. Periphery of the last whorl marked by a weak cord. Base short, slightly rimate, well rounded, and marked by the continuation of the axial riblets. The last whorl is solute for about one-twentieth of a turn. Aperture irregularly broadly oval. Peristome moderately expanded and reflected. Columella in the last whorl broad, hollow, and

marked by weak, retractively curved hair lines. On the last whorl it becomes a little more slender and has a slight twist.

The type, U.S.N.M. no. 543585, was collected by Miss Bourgeois at Omiltemi, Guerrero, in the Sierra Madre Mountains. It has 8.3 whorls remaining and measures: Length, 24.5 mm; greatest diameter, 7.7 mm. U.S.N.M. no. 543586, collector's no. 992, U.S.N.M. no. 543587, collector's no. 993, and U.S.N.M. no. 543588, collector's no. 983, contain 13 topotypes from the same source. Four more specimens are in Miss Bourgeois's collection.

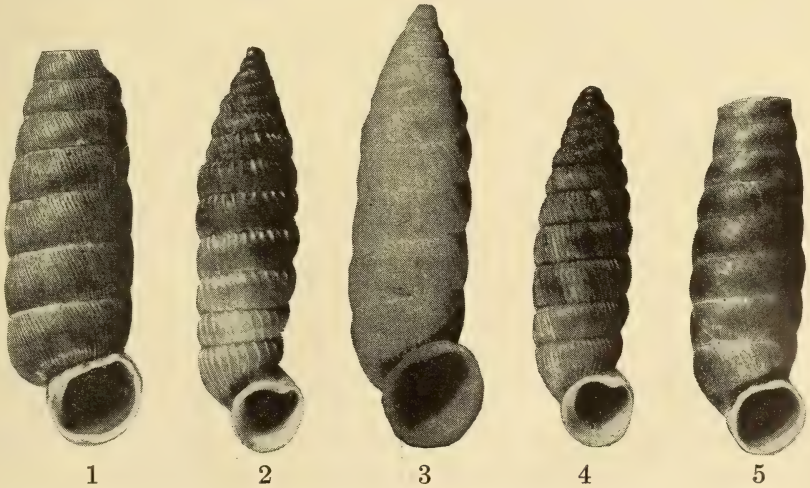
This species in size appears to resemble most closely *Coelocentrum dispar* Pilsbry, from Guatemala, from which, however, its much finer sculpture will distinguish it.

Genus **Holospira** von Martens

Holospira rehderi, n. sp.

Fig. 2

Shell small, cylindroconic, thin, semi-translucent, grayish white, with the peristome and interior of the aperture white. The nucleus consists of a little more than 2.5 whorls, which are well rounded and minutely granulose. The postnuclear whorls increase regularly in size, reaching their maximum diameter on the tenth whorl, beyond which they again decrease gradually in size. They are well rounded on the early turns but become flattened on the later whorls. The early postnuclear whorls have decidedly retractively slanting riblets, which are most numerous on the first turn where they are about one-third as wide as the spaces that separate them. Anterior to the middle of the spire the ribs are strengthened at the summit, becoming almost nodulose here. They weaken on the middle of the turns and again become strengthened near the suture, thus giving one the impression of slight obsoleteness on the middle of the whorls and granulation at the summit. Twenty-four ribs are present on the tenth whorl. Behind the aperture of the last turn the ribs become closely crowded, while on the middle of the turns they are separated by spaces about three or four times as wide as the ribs. Suture strongly constricted. Periphery of the last whorl well rounded. Base somewhat attenuated, well rounded, with a deep umbilical chink. Last whorl solute for about one-tenth of a turn. Aperture broadly pear-shaped. Peristome expanded and reflected. The columella is slender with a very slight twist. The columella bears a strong median fold in the penultimate whorl, which is about one-fourth as wide as the turn. In the antepenultimate whorl this fold becomes a little slenderer and a little wider. In this turn the parietal wall has pendent from its middle a broad lamella, which is concave above and which approximates the medial basal lamella, which is concave on its anterior side, the two leaving a mere slit between them into which the columellar fold points. The fold on the outer lip is slender and threadlike and also points toward the slit between the major lamellae. Posterior to the penultimate turn the lamellation disappears.



FIGS. 1–5.—New species of Mexican urocoptids: 1, *Oligostylus mariae;* 2, *Holospira rehderi;* 3, *Haplocion wilmoti;* 4, *Holospira morelosensis;* 5, *Coelocentrum huertai.*

The type, U.S.N.M. no. 543589, was collected by Miss Bourgeois at Chietla, Puebla, under stones. It has 14 whorls and measures: Length, 14 mm; greatest diameter, 3.9 mm. U.S.N.M. no. 543590 contains 24 topotypes from the same source. Ten additional specimens are in Miss Bourgeois's collection.

This species recalls *Holospira albertoi* Bartsch from Petlalcingo, Puebla, in the distant spacing of the axial ribs, but differs completely from that in general shape, which here is more pupoid, and also in the weakening of the ribs on the middle of the turns.

Holospira morelosensis, n. sp.
Fig. 4

Shell small, elongate-pupoid, thin, yellowish horn-colored, with the peristome and aperture white. Nuclear whorls about 2, strongly rounded and minutely granulose. The postnuclear whorls increase gradually in size up to the eighth whorl and again become slightly narrower toward the last turn. They are well rounded on the early turns and almost flattened on the broad portion of the spire, curving, however, even here toward the summit. Suture strongly constricted. The whorls are marked by strong, sublamellose axial ribs, which are a little weaker on the expanding spire than on the broader portion of the shell where they are about half as wide as the spaces that separate them. These ribs become slightly thickened at the summit which renders them almost crenulated. They are retractively slanting except on the last turn where they are vertical. Of these ribs, 51 are present on the penultimate turn. Periphery well rounded. Base slightly produced, well rounded, deeply rimate, and marked by the continuation of the axial ribs. The last whorl is solute for about one-tenth of a turn, and the solute portion is rendered carinate at the posterior angle. Aperture subcircular. Peristome expanded and reflected with a slight nodular thickening on the parietal wall near the posterior angle. The columella is twisted on the last turn and slightly twisted in the early whorls. In the penultimate whorl a median fold, rounded at the free edge and extending over almost half the width of the turn, is present. A broad parietal fold, concave on the outside, extends almost halfway across the turns, while on the basal area a fold half as wide projects toward the edge of the parietal fold. The labial fold is submedian and consists of a mere thread. All these folds are confined to the penultimate turn.

The type, U.S.N.M. no. 543591, was collected by Miss Bourgeois at Tlaquiltenango, Morelos. It has 12.5 whorls and measures: Length, 12.1 mm; greatest diameter, 3.5 mm. U.S.N.M. no. 543592 contains 10 topotypes from the same source, collector's no. 941. Five additional specimens are in Miss Bourgeois's collection.

This species does not closely resemble any of the known forms, and therefore it would be futile to attempt to compare it with them.

Genus **Haplocion** Pilsbry

Haplocion wilmoti, n. sp. Fig. 3

Shell moderately large, cylindroconic, white. Nuclear whorls 2.3, well rounded, microscopically granulose. The postnuclear whorls increase gradually in size until the sixth postnuclear turn. From there on the shell becomes cylindric, being slightly constricted on the base of the last whorl. All the whorls except the last one are marked by retractively curved lines of growth, which almost in places simulate obsolete riblets. On the last turn the base and the anterior half of the turn are marked by axial ribs, which extend into the umbilicus. Suture moderately constricted. Base well rounded, with an umbilical chink. Last whorl slightly solute. Aperture almost subcircular, broadly expanded and reflected. The columella is hollow and rather narrow, with an extremely weak fold in the penultimate turn.

The type, U.S.N.M. no. 543595, was collected by George Wilmot under large rocks in the mountain near the City of Chihuahua. It has 12.5 whorls and measures: Length, 30 mm; greatest diameter, 10 mm. U.S.N.M. no. 543596 contains a topotype from the same source, and still another is in the collection of Miss Bourgeois.

This species most nearly resembles *Haplocion semisculpta* Stearns, which also comes from Chihuahua. It differs from it in being much larger and in having the axial ribs limited to the last turn. In *semisculpta* they extend posteriorly for three or more turns.

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ENGINEERING.—*Beach intelligence.*[1] MARTIN A. MASON, Beach Erosion Board, War Department.

In the first confusing and busy days of the war we at the Beach Erosion Board set out to find the part it could play in the all-out endeavor. Although its main role, in time, became that of a contributor to beach intelligence, this part was not clearly defined in the early days. Of course, at that time, even the idea of the need for such intelligence was new, so for some months the Board's work was limited to special problems concerning beach characteristics.

In the early stages little was known about the requirements for beach intelligence, nor were specific instructions included in the requests for intelligence. As a result, there was developed a series of approaches that gradually resulted in satisfactory intelligence as actual landing operations showed the need for specific types of information. Moreover, it developed that two broad types of reports were needed: a brief graphic report for strategic planning, and a fully detailed report for operations.

The strategic planning reports were prepared usually on order of the Joint Chiefs of Staff. This type of report was intended to give, in as concise form as possible, the physical characteristics of a fairly large area, usually an island, peninsula, or other major area, and to indicate where men and equipment could or could not be landed. An attempt was made to present the material on a single sheet, usually a hydrographic chart, to facilitate reading, and to keep the report unencumbered with detail. Often because of the briefness of the report, it was necessary to emphasize only the most important or hazardous physical features of the area. Such general information was called for as the extent and width of the fringing coral reef and the general characteristics of a coral beach. Brief coastal descriptions gave more specific information on each outlined area.

For the operational type report, the description of a beach area was undertaken in four sections and was accompanied by maps, charts, and aerial and ground photographs. The following data were usually furnished:

I. LOCATION AND EXTENT:
  A. Geographic coordinates of beach limits and length of beach.
  B. Importance of beach.
    1. With respect to physical characteristics.
    2. With respect to nearness of objectives.
  C. Description of local landmarks.

II. NEAR SHORE (includes area from 30-foot depth to low water line):
  A. Location of depth contours, usually 6-, 12-, 18-, and 30-foot depths.
  B. Location and depths over shoals, bars, etc.
  C. Location and description of anchorage areas.
  D. Description of bottom materials.
  E. Tidal information.
    1. Tidal range.
    2. Local peculiarities.

[1] Received April 9, 1947. This paper, and the one following by George W. Irving, Jr., are summaries of research for which the Awards for Scientific Achievement for 1946 were made by the WASHINGTON ACADEMY OF SCIENCES on March 20, 1947. Dr. Mason was given the award representing the Engineering Sciences in recognition of his service in erosion studies leading to successful beach invasions by Allied Armed Forces during the War. Dr. Irving received the Award for the Physical Sciences for his work in biochemistry, especially for his researches on antibiotics in tomato plants. The Award for the Biological Sciences was granted to Dr. Waldo R. Wedel, archeologist of the U. S. National Museum, in recognition of his contributions to the prehistory of human ecology in the Central Great Plains. Inasmuch as reports upon Dr. Wedel's work have been published in full by the Smithsonian Institution, it is not further summarized here.—EDITOR.

3. Direction and strength of tidal currents.

F. Winds.
1. Direction and occurrence.
2. Effect on tides and currents.

G. Waves and surf.
1. Direction of approach.
2. Characteristics.

III. Characteristics of Beach (the beach is defined as an area of unconsolidated material between the low water line and the upper limit of wave wash):
A. Length and width, at high and low water.
B. Composition, slope, and relative firmness (above and below high water).
C. Interruptions in beach.
1. Location.
2. Variations in beach characteristics along interruptions.
D. Direction of shore drift.
E. Local use of beach.
F. Location of any beach structures.

IV. Terrain Immediately Behind and Adjacent to Beach:
A. Topography.
B. Exits from beach proper.
C. Access to utilities and communication lines.

Fig. 1 shows one of the maps from a fairly early report. It is an enlargement to 1:50,000 of the Narbonne sheet of the French 1:80,000 series. On it, the beaches have been noted, numbered, and described briefly. The 6-, 12-, 18-, and 30-foot contours are shown and bottom gradients to the 12-foot depth are given at intervals. At the right, the shore line has been revised from aerial photographs.

The following pages of the report included the descriptive text and charts and photographs which illustrated these beach areas.

The preceding discussion has shown that a wide variety of information is required in preparing beach intelligence reports. Data for the Board's reports came from varied and widespread sources. All published literature was used as far as was possible. In it were included engineering, geological, geographic, and oceanographic journals; travel books; and sometimes even nature books on such subjects as bird life. Beach information was often found under very odd titles. All available publications of other Governmental agencies were used as were all available maps and charts published by United States agencies and by foreign powers. Recent aerial photographs were most valuable, and when available, lessened the importance of the widespread and sometimes rather vague literature sources.

Proper interpretation of such source data together with a knowledge of beach processes and the interrelationships between beach characteristics produced intelligence reports. The nature of the source data and the amount of interpretation required governed the reliability rating which could be given to the report of any particular beach area. The importance of the specialized knowledge, however, can not be overemphasized, even though some of this knowledge is not yet concrete or set down experimentally in quantitative terms. Broadly speaking, interpreting and correlating known beach data into a complete descriptive picture, required some knowledge of the following items:

1. The characteristics of waves, currents, and tides; and the effect of meteorological conditions on these phenomena.
2. The probable relationship between the nature of source deposits and the composition, width, and surface features of the beach.
3. The relationship of beach slope to such factors as composition, surf, and exposure.
4. The relationship of near-shore bottom gradients to surf intensity and characteristics.
5. The relationship between predominant shore currents and beach configuration.
6. The relationship of beach firmness to such items as composition, season, or exposure of the beach.
7. The relationship between such special beach features as beach cusps, and composition, season, or surf.
8. The interpretation of beach and underwater features and the determination of underwater depths from aerial photographs.

For an insight into these relationships, it was necessary to draw on wide experience in studying beaches along our own coast and on data which verified some of the trends of these relationships. For example, beach slopes are of major importance in some landing operations and yet specific information on slopes was often lacking. It was, however, often possible to predict the order of magnitude of the slope from knowledge of particle size, exposure of the beach and other factors.

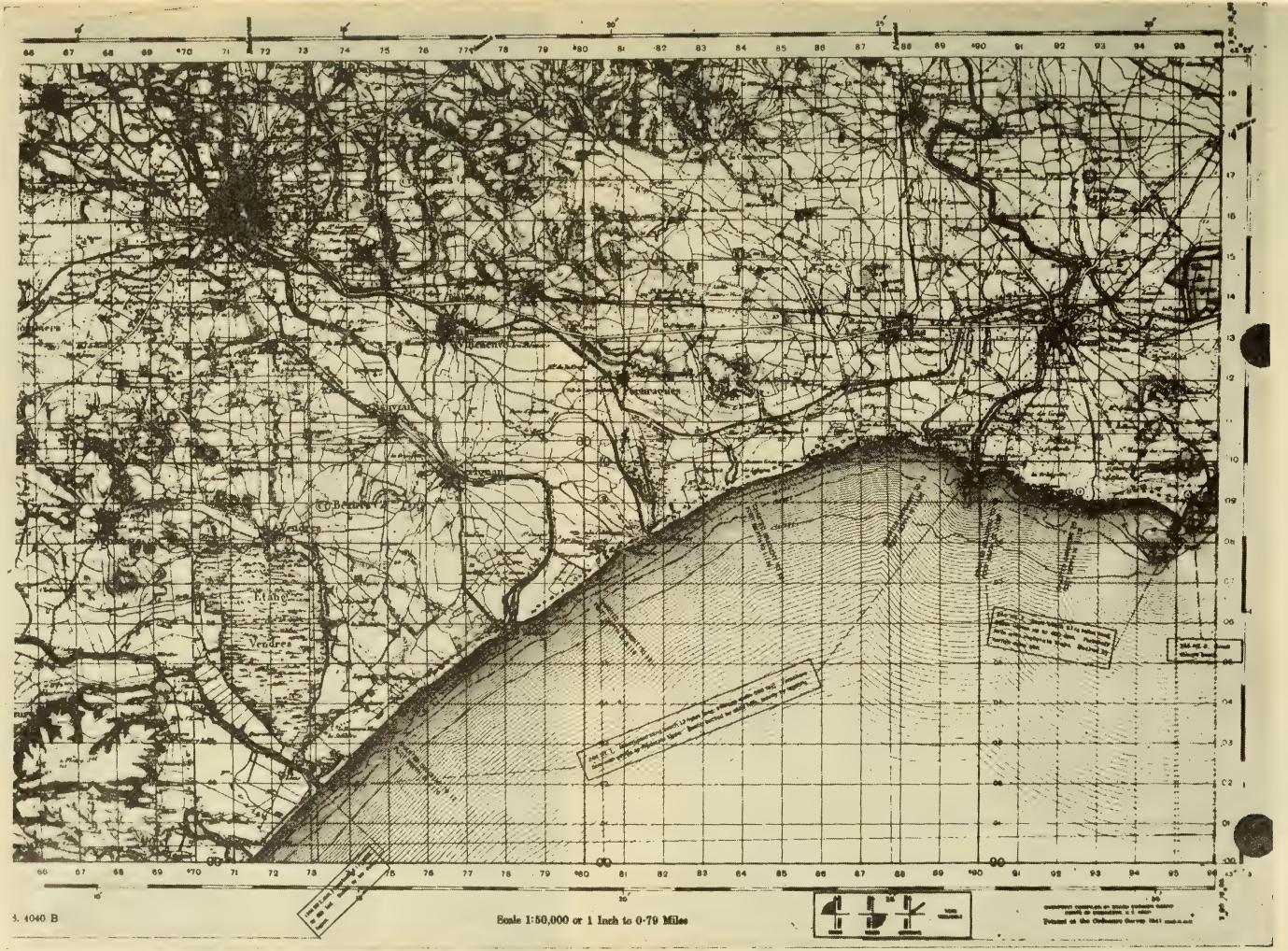


FIG. 1.—Typical map from early study showing method of reporting beach and near-shore information. Note revision of shore line at right of picture from aerial photographs.

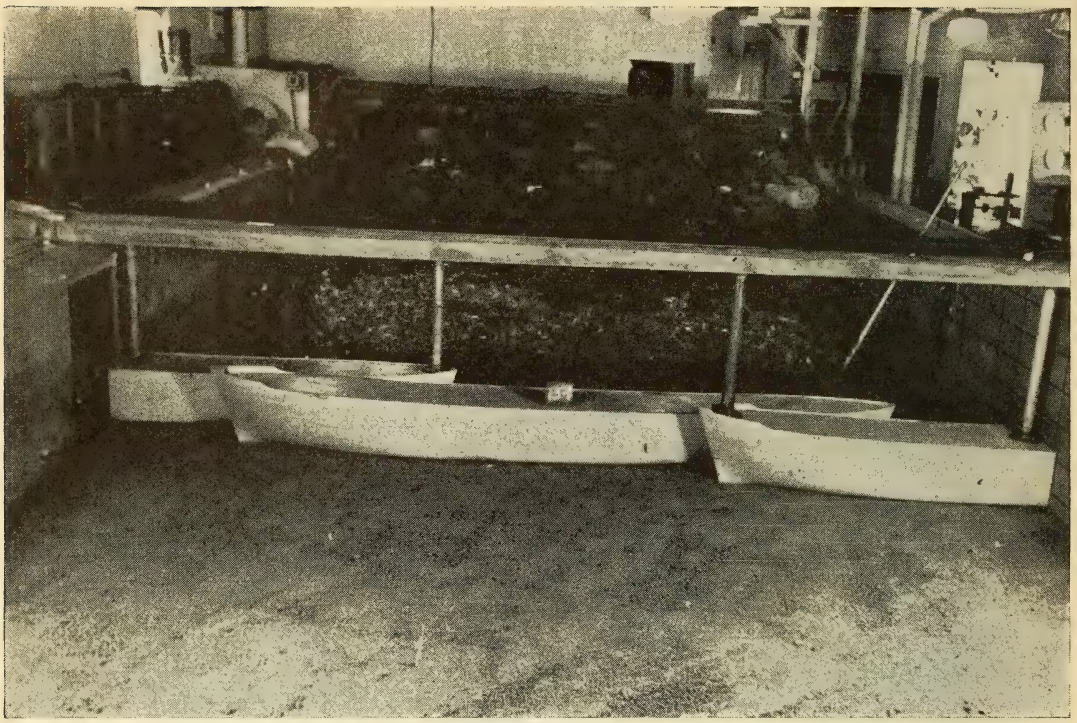


FIG. 2.—Model of sunken Liberty ship aligned as incorporated in artificial harbor. View prior to test under storm-wave forces.

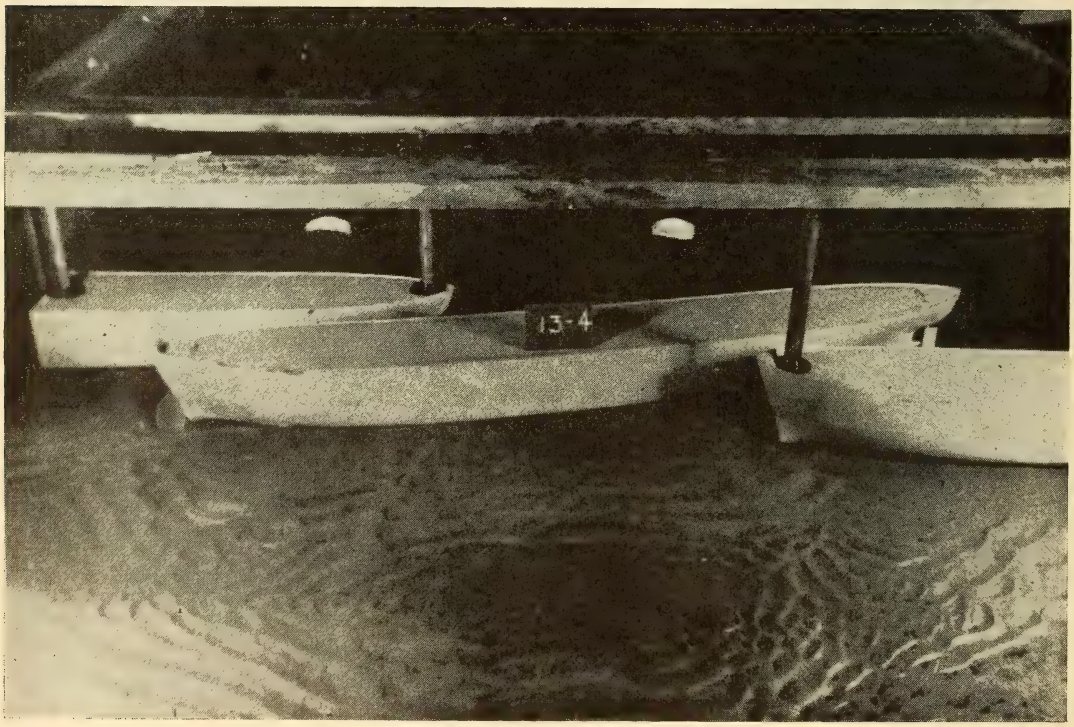


FIG. 3.—Model of sunken Liberty ship after test under storm-wave forces. Note displacement of model and erosion under bow.

This brief description of the work involved in preparing beach intelligence has indicated some of the problems that had to be overcome. The problems, of course, varied in degree with the amount and the reliability of the source data available. Beach intelligence, when prepared at a point far removed from operations, is still to some extent an art and not a science.

In addition to preparing beach intelligence reports, there was conducted laboratory experimental work which had direct bearing on the war effort. These experiments covered such items as the determination of depths over offshore bars or other bottom discontinuities and the characteristics of waves approaching a beach.

Other agencies were aided by wave tank experiments to determine the effects of storms and wave forces on pontoons or sunken ships designed as artificial harbors. Figs. 2 and 3 show before and after views of one of the test runs of storm waves on sunken model Liberty ships. In these experiments, an attempt was made to determine the best method of aligning the sunken ships to withstand wave forces. These tests were confirmed by experience during the Normandy invasion.

Acknowledgment is made of the great aid of Dr. W. C. Krumbein, Jay V. Hall, and Mrs. Clara Edmunds, my colleagues in this work.

BIOCHEMISTRY.—*The significance of tomatin in plant and animal disease.*[1] GEORGE W. IRVING, JR., U. S. Bureau of Agricultural and Industrial Chemistry.

The elucidation of the biochemical nature of disease resistance in plants is a subject of challenging interest and one that is engaging the attention of this and other laboratories. Nearly all plants are prey to certain bacterial, fungal, or virus diseases. In many cases such diseases are responsible for major crop failures, which result in economic losses to the farmer, reduction in the supply of farm produce, and, ultimately, in increased costs to the consumer. For these reasons, plant-disease control has long been a problem of paramount importance to the agricultural scientist. Great progress in plant-disease control has been made through the development and application of bactericidal and fungicidal chemicals and through improvements in general farm practice. High in importance in minimizing the inroads of disease in plants has been the development, through intensive plant-breeding experiments, of varieties of economically important plants that are highly resistant to specific disease-causing organisms. By such means it has been possible to develop, in the case of many plants, varieties that will grow and produce in spite of infection (*1*, *2*). As a result of these experiments the plant geneticist can now provide plant-disease investigators with, for example, two tomato plants that will appear almost identical as to foliage and as to quality and size of fruit when grown in clean soil. However, when these plants are grown side by side in soil that is infested with the fungus *Fusarium oxysporum* f. *lycopersici*, one will wilt and die while the other will remain vigorous and produce fruit. One of these tomato plants is able to resist infection by *Fusarium* and survive, while the other is not able to resist the infection and succumbs. What is it then, in the chemical make-up of the plant that survives infection that is responsible for its resistance to wilt disease? This is the question for which it is hoped a reasonable answer can be found. It is believed that a full understanding of the chemical factors involved in conferring resistance upon a specific plant (the tomato) toward a specific disease organism (*Fusarium*) may provide clues upon which new and perhaps better methods for controlling disease in the tomato plant can be based. It is possible, further, that the knowledge gained in the biochemical study of disease resistance in the tomato plant may reveal factors of general significance to aid in the elucidation of the disease resistance mechanism of other plants to other pathogens.

[1] Received April 24, 1947. See footnote 1 of preceding article.

Investigations were initiated in this laboratory on the basis of a simple working hypothesis, namely, that certain tomato varieties are resistant to *Fusarium* wilt because they are able to produce an antibiotic agent or agents in sufficient quantity to inhibit the growth of the invading fungus. Early in the work partial substantiation of this hypothesis was obtained (*3*). It was found that the resistant tomato plant does elaborate a substance that markedly inhibits the growth of *Fusarium in vitro*, that the substance could be concentrated by suitable fractionation procedures, and that it satisfied the prerequisites of an antibiotic agent. This antibiotic agent from the tomato plant is now designated tomatin.[2]

During the past two years intensive efforts have been made to explore as fully as possible the many interesting lines of investigation that the discovery of tomatin has suggested. Research has been directed with four main objectives in view: (*a*) to isolate tomatin in the pure state and, once this is accomplished, to characterize it chemically; (*b*) to determine the antibiotic spectrum of tomatin, that is, to determine which microorganisms it inhibits and which it does not; (*c*) to ascertain the role, if any, played by tomatin in protecting tomato plants against *Fusarium* wilt; (*d*) to investigate the possible occurrence of tomatin or tomatin-like substances in other plants. Much of this program still remains to be accomplished, but substantial progress has been made toward the achievement of each of the four objectives. It is known that tomatin is a water and alcohol soluble, remarkably heat stable, organic compound of relatively low molecular weight (*3*, *5*); that it inhibits many other organisms besides *Fusarium*, among them bacteria, other fungi and yeastlike forms (*5*, *6*); that tomatin or similar substances occur in plants like the potato, sweet potato, cabbage, and pepper but are absent from a majority of the other plants that have been examined (*5*); and finally that tomatin occurs in wilt-susceptible as well as in wilt-resistant tomato plants but probably to a greater extent in the latter (*3*, *7*).

The discovery that tomatin is present in wilt-susceptible tomato plants was somewhat disappointing since, obviously, it would have been most attractive to be able to explain the susceptibility of certain tomato plants to wilt on the basis of the complete absence of tomatin from such susceptible varieties. Since this is not the case, attention was turned to the investigation of the effect of infection by *Fusarium* on the tomatin level in resistant and susceptible tomato plants. In these experiments it was found on the one hand, that a high level of tomatin is maintained in resistant tomato plants able to survive even though they are badly infected; on the other hand, it was found that tomatin gradually disappears from susceptible plants as invasion by *Fusarium* proceeds and that tomatin is completely absent from wilted and dying plants.

From these results it has been concluded tentatively that wilt-resistance or wilt-susceptibility in the tomato plant does not necessarily depend upon the presence or absence of tomatin, but rather upon the rate at which the plant is able to elaborate tomatin as the need for this protective substance arises. If the metabolic processes of a given tomato variety are capable of producing tomatin at a rate sufficient to

[2] The difficulty that has been experienced in selecting a suitable, unique name for this antibiotic agent demonstrates the pitfalls that confront those who would attempt to coin distinctive names for unidentified substances of biological origin. The substance was first named "lycopersicin," a term derived from *Lycopersicon*, the genus to which the tomato plant belongs. It was soon learned, however, that the term lycopersicin had been used previously to designate the red pigment of the tomato (*4*), and, although the use of the term in this sense was abandoned immediately owing to the more general acceptance of the term lycopene, it was considered wise, nevertheless, to abandon its use as a designation for the antibiotic agent from the tomato plant in order to avoid any possible confusion. After much deliberation the antibiotic was renamed "tomatin," derived simply from the name tomato. Very recently it has been learned that the term tomatin has also been used previously to designate an alcoholic beverage of foreign manufacture. In this instance, however, there seems to be little likelihood of confusion, and it is anticipated that the term tomatin will be retained to designate the antibiotic agent until its eventual isolation and identification may make it preferable to rename it in accordance with accepted chemical nomenclature.

maintain a protective level in the plant, then that variety will be resistant to wilt; if an adequate rate of tomatin production can not be maintained, the variety will be susceptible to wilt. While this conclusion is plausible in the light of the data, conclusive proof of its validity has not yet been obtained. It is known that wilting is accompanied by a disappearance of tomatin, but it can not be ascertained on the basis of the information now available whether tomatin disappears because the plant wilts or the plant wilts because tomatin disappears. The answer to this question, and an investigation of the mechanism whereby tomatin is produced by the plant, are among the more interesting problems for future investigation.

As has been mentioned, the antibiotic effectiveness of tomatin is not confined to the fungus *Fusarium*. It does, in fact, inhibit much more strongly cultures of certain of the fungi that cause disease in humans; among the organisms inhibited are those responsible for the dermatophytic infections such as ringworm and athlete's foot, and the more serious, often systemic infections such as blastomycosis, coccidioidomycosis, and histoplasmosis (*5*, *6*) (Tables 1 and 2). To many this is perhaps the most interesting aspect of the work on tomatin, since a fungistatic agent suitable for parenteral use in humans is sorely needed by the medical profession. This is understandable, since no successful therapy exists at present for either the mild local infections or the serious systemic fungus infections in man. Tomatin is by no means the only antibiotic agent that possesses marked fungistatic properties, but those that have been tested heretofore are of limited clinical usefulness because of their toxicity (*8*). Accordingly, vigorous efforts are being made to ascertain the potentialities of tomatin for the treatment of fungus diseases in humans. The knowledge that tomatin inhibits these pathogenic fungi in culture represents only the first step in such an investigation. To be useful for human therapy tomatin must be shown to be of sufficiently low toxicity to permit safe administration or application in man and to be effective against these same fungi in man. Whether tomatin possesses desirable properties in this regard is now being determined in cooperative experiments with the Duke University School of Medicine. These experiments have not yet progressed to the point where definite conclusions regarding the toxicity or *in vivo* effectiveness of tomatin can be drawn.

All the lines of research mentioned earlier in this report are being prosecuted as actively as possible. However, in all this work, and in plans for the future extension of these investigations, the isolation of tomatin in the pure state and its identification are of first importance. It is for this reason that the major current effort is being expended in this direction. Once tomatin has been obtained pure and its chemical nature are known it is probable that many of the present uncertainties regarding its possible role in the disease resistance mechanism of tomato plants and its possible effect upon the human organism can be clarified in direct, uncomplicated experiments.

The author takes pleasure in expressing his appreciation and indebtedness to his friends and associates Dr. Thomas D. Fontaine, Dr. S. P. Doolittle, Dr. Roberta M. Ma, and Mrs. Janet B. Poole, whose enthusiastic efforts have been largely responsible for the results presented in this report.

TABLE 1.—ORGANISMS WHOSE GROWTH IS COMPLETELY INHIBITED BY THE PRESENCE OF 1 UNIT TOMATIN PER ML. OF CULTURE MEDIUM

Organism	Disease and remarks
Candida (Monilia) albicans	Moniliasis (thrush, bronchomycosis).
Cryptococcus neoformans, *Debaryomyces histolytica*	Cryptococcosis (European blastomycosis, torulosis).
Trichophyton mentagrophytes, *Trichophyton interdigitale*, *Trichophyton rubrum*, *Trichophyton gypseum*, *Epidermophyton floccosum*, *Microsporum audouini*, *Achorion gypseum*, *Achorion schoenleinii*	The dermatomycoses (ringworm, athlete's foot, etc.).
Blastomyces dermatitidis	North American blastomycosis.
Coccidioides immitis	Coccidioidomycosis.
Histoplasma capsulatum	Histoplasmosis.

TABLE 2.—ORGANISMS WHOSE GROWTH IS PARTIALLY INHIBITED BY THE PRESENCE OF 1 UNIT TOMATIN PER ML. OF CULTURE MEDIUM

Organism	Disease and remarks
Fusarium oxysporum f. lycopersici	Tomato wilt.
Fusarium oxysporum f. pisi	Pea wilt.
Fusarium oxysporum f. conglutinans	Cabbage yellows.
Fusarium oxysporum f. lini	Flax wilt.
Actinomyces scabies	Potato scab.
Sporotrichum schenckii	Sporotrichosis.
Monosporium apiospermum	Madura foot, mycetoma)
Aspergillus niger, *Aspergillus clavatus*, *Penicillium notatum*	Rarely pathogenic.
Staphylococcus aureus	Gram positive.
Bacillus cereus	Gram positive.
Bacillus mycoides	Gram positive.
Bacillus subtilis	Gram positive.
Escherichia coli	Gram negative.

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BIOPHYSICS.—*Harmony among vital substances.*[1] LUIS FELIPE VEGAS, Ministry of Public Works, Caracas, Venezuela. (Communicated by ALEXANDER WETMORE.)

As vital substances we here consider those, such as water, blood, etc., which are indispensable to the existence of man and the majority of living things. We have also placed under this heading those substances which are produced by a living organism, such as the aqueous and vitreous humors of the eye, or those of significance in the digestive process as saliva and hydrochloric acid. Finally, we have included those which are important in the conservation of species, as milk, etc.

From the chemical point of view, it is very difficult to establish a relationship of similarity between these substances. This is clearly seen in the case of hydrochloric acid and albumen, in that the simplicity of the former (HCl) is in striking contrast to the complex form of the latter, which, according to A. Gautier, is: C^{250} H^{409} N^{67} O^{81} S^{3}.

If we take into consideration the physical properties of these substances, we notice that they have certain similarities, since many are liquid at ordinary temperature, and all, in conformity with the latest theories, may have similar electronic arrangements. However, the similarity we shall discuss is a new aspect of the close relationship that exists between these substances. In 1937, we published a paper entitled *A study of the relations which exist between specific inductive capacity, the index of refraction of light, and density.*[2] In that

[1] Revised from the author's article *La armonía entre las sustancias vitales*, Bol. Soc. Venezolana Cienc. Nat. **9** (59): 163–166. 1944. Translated from the Spanish by Pedro J. Baldó and Armando Lazzari. Received February 5, 1946.

[2] Revista Colegio Ingenieros Venezuela **14** (123): 133–144. 1937.

paper we pointed out the relationship existing between the indices of refraction of groups of substances and their respective densities. This relation, with which we are now concerned, came under the caption of "Second Law," which reads: "There exists in a given substance a constant relation between the index of refraction raised to the nth power and its density. I being the index of refraction, and D the density, we have: I^N/D = a constant. For each value of N there are an undetermined number of group-forming substances. To these groups we may give, as a characteristic, the same number which expresses the value of N. Thus, group 2 will be formed by all substances where $N=2$, and group 3 by those where $N=3$, etc."

GROUP 3

Substance	Refractive index I*	I^3	Density D (relative to air)	$\frac{I^3}{D}$
Water	1.3330	2.3686	772.026	$(3.06)10^{-3}$
Human blood	1.3540	2.4823	815.921	(3.04) "
Albumen	1.3510	2.4658	804.331	(3.06) "
Blood serum	1.3483	2.4511	794.277	(3.08) "
Urea	1.4840	3.2680	1,032.482	(3.16) "
Succinic acid	1.5338	3.6082	1,201.856	(3.00) "
Vitreous humor	1.3400	2.4061	777.262	(3.09) "
Aqueous humor	1.3400	2.4061	777.262	(3.09) "
Saliva	1.3390	2.4007	777.958	(3.08) "
Hydrochloric acid†	1.4100	2.8032	920.340	(3.04) "
Woman's milk	1.3484	2.4516	798.662	(3.07) "
Cow's milk	1.3500	2.4604	798.298	(3.08) "
(dl) Lactic acid	1.4414	2.9947	965.970	(3.10) "
Urine	1.3400	2.4061	787.316	(3.05) "
$(1-\alpha)$ Arabinose	1.5670	3.8477	1,225.831	(3.14) "
1-Xylose	1.5440	3.6807	1,179.427	(3.12) "
Average of the quotients				(3.07) "

* The indices of refraction which appear in both tables are referred to sodium light.

† Concentrated aqueous solution. However, pure hydrochloric acid (liquefied hydrochloric gas) also belongs to group 3. From liquefied hydrochloric gas at a temperature of 16° C we get: $I=1.252$; $I^3=1.9625$; $D=645.785$; $I^3/D=(3.04)10^{-3}$.

If we now try to find out to which of the groups the vital substances belong, we shall see that the few of them which we have been able to investigate come under groups 3 and 2, as they are listed herewith in tabular form.

In both tables, opposite the name of every substance, we find: first, its index of refraction relative to air; second, the same index raised to the nth power; third, its density relative to air[3]; and fourth, the ratio I^N/D.

It is interesting to note that the substances such as urea, succinic acid, arabinose, and xylose, the quotients of which greatly differ from the average, are all anisotropic. That is, their physical properties differ for every direction about a point and, in a general way, they do not obey the Snellius-Descartes laws of refraction.

In the case of urea, which is uniaxial, the ordinary index was used, and the intermediate index for the other three, which are biaxial.

The inclusion of hydrochloric acid and water in the table of group 3 does not permit applying the term "organic substances" to this group. A different denomination being necessary, the denomination "vital substances" was adopted.

GROUP 2

Substance	Refractive index I	I^2	Density D (relative to air)	$\frac{I^2}{D}$
Sardine oil	1.4802	2.1909	717.246	$(3.05)10^{-3}$
Herring oil	1.4780	2.1845	711.678	(3.07) "
Menhaden oil	1.4800	2.1904	716.937	(3.05) "
Cod-liver oil	1.4790	2.1874	713.070	(3.07) "
Shark-liver oil	1.4743	2.1735	718.174	(3.02) "
Dolphin oil	1.4688	2.1573	717.169	(3.01) "
Seal oil	1.4741	2.1729	714.617	(3.04) "
Spermaceti	1.5030	2.2590	730.858	(3.09) "
Lard oil	1.4686	2.1568	705.491	(3.06) "
Sheep's-foot oil	1.4680	2.1550	709.590	(3.04) "
Neat's-foot oil	1.4730	2.1697	707.656	(3.06) "
Horse's-foot oil	1.4680	2.1550	706.109	(3.05) "
Average of the quotients				(3.05) "

It may interest physiologists to know that acetone belongs to group 2, in which the fats are grouped. From acetone we get: $I=1.3593$; $I^2=1.8477$; $D=611.755$; $I^2/D=(3.02)10^{-3}$

Although we have said that I^N/D is a constant, we find small differences in the lists of quotients. This is probably due to the fact that (besides what has already been said about anisotropic substances) the same sample was not always used in meas-

[3] To obtain the densities referred to air, multiply the density referred to water by 773.395.

uring the index of refraction and the density of the substances. It could also be explained by the fact that the temperature was not the same at the times when the index of refraction and density were being measured. It may also be the result of both causes acting simultaneously. Nevertheless, in the case of water, the index of refraction (1.33299) and the density (0.99823 or 772.026 relative to the air) were very carefully measured at a fixed temperature of 20° C. This determination allows us an accurate value for the term I^N/D and an approximate value could also be obtained by computing the average of all the values for this term in both groups. Doing so, we find that the average value obtained is almost identical to the one corresponding to water, differing, only by 11 in the seventh decimal place.

Quotient I^3/D for water.....0.0030679
Average of all the quotients.....0.0030668

CONCLUSION

The relation shown in the tables between the index of refraction and density reveals the existence of a similar internal arrangement among the substances belonging to the same group. As the constant $I^N/D = (3.0679)10^{-3}$ is the same for both groups it is quite possible that this indicates the existence of some equilibrium or arrangement between both groups.

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ETHNOLOGY.—*Further light on the Delaware Indians as women.*[1] C. A. Weslager, Wilmington, Del.

The author's first essay relating to the feminization of the Delaware Indians by the Five Nations Iroquois reopened an old subject which aroused several correspondents to concur and dissent with the views expressed and stimulated other papers on the same theme.[2] In view of the divergence of opinion the present essay is subjoined to the first as a means of clarifying the writer's position and of introducing new data in support of the following premises:

1. The Five Nations in effect conquered the Delaware prior to 1712, forcing them to pay tribute. Either as a direct result of the conquest or through some subsequent act on the part of the Delaware, they were "feminized" by the Iroquois.

2. In the position of "women" the Delaware were deprived of certain masculine prerogatives and remained in the status of partial vassalage until 1756, when, under the leadership of the chief Tedyuskung, they were emancipated.

3. During the period when they were recognized as "women," not only by the Iroquois but also by themselves and other Indian tribes, the Delaware were not accorded treatment as honored matrons. In fact, they were often humiliated and treated contemptuously.

4. Other tribes during the same period differentiated between the status of warrior "men" and noncombatants allegorically termed "women." However, the position of women in tribal society differed areally, and females were not necessarily considered as inferiors.

The data offered in the original paper and the material herein presented must be

[1] Received May 26, 1947.

[2] Weslager, C. A. *The Delaware Indians as women,* Journ. Washington Acad. Sci. **34**: 381–387. 1944.

Speck, Frank G. *The Delaware Indians as women,* Pennsylvania Mag. Hist. and Biogr. Oct. 1946: 377–389. In addition, a manuscript has been submitted to the Pennsylvania Archaeologist by Anthony Wallace entitled *The status of the Delaware Indians in the Iroquois Confederacy.* The writer had the privilege of reading this essay, which at this writing has not yet been published.

accepted solely as accounts found in State records, lacking in ethnographic detail and leaving many questions unanswered. Nevertheless, the colonial records stand among few contemporary accounts accessible today and must be given full credence. The writer does not agree that these records are of questionable value because they were written by white scribes untrained in ethnic observation. Actually, the Indian speeches were interpreted by men thoroughly familiar with native institutions and dialect, and in some cases the interpreters themselves were of Indian descent. Indian relations prior to 1800, especially in Pennsylvania, were of great moment, and after carefully perusing the provincial records it is my opinion that native ideology was preserved as nearly as possible. In negotiations between whites and Indians, the Indian custom of exchanging wampum belts predominated; the figurative language employed was in accordance with native expression as was the method of protracted deliberation during negotiations.

Apart from the colonial records information derives from other accounts which epitomizes the relations between whites and Indians. For example, the practice of the Five Nations in demanding tribute from subjugated tribes is succinctly described by a contemporary author and observer who wrote: "All the Nations round them have for many Years intirely submitted to them and pay a yearly tribute to them in Wampum; they dare neither make War nor peace without the consent of the Mohawks [i.e., Five Nations]. Two old Men commonly go about every Year or two to receive this Tribute; and I have often had the Opportunity to observe what Anxiety the poor Indians were under while these two old Men remained in that part of the country where I was."[3]

In a separate volume, now in preparation, I have discussed the bead tribute paid the Five Nations by the Conoy and Nanticoke.[4] Of the Conestoga (Susquehannah-Minquas) it was recorded that they "actually pay tribute to the Five Nations, and either from natural affection or Fear are ever under their influence.[5]

Of the Delawares, it was written in 1698: "That the Delaware Indians live at Minguannan about nine miles from the head of Elke River & fifteen miles from Christeen & Thirty miles from Susquahanah & are about Three hundred red men & *are tributary to the Senecars* [Seneca] and Susquehannahs fifty of them living at Minguhanan & the rest upon Brandywine and Upland Creeks."[6]

This deposition specifically refers to the Unami, and the area described is in northern Delaware and southeastern Pennsylvania. However, Munsi and/or Mahicanni are referred to as the vanquished in the following statement made by the Dutch navigator De Vries, based on his observations made prior to 1650 in the Hudson River region: "This tribe of Indians [Munsi or Mahicanni] was formerly a powerful nation, but they are brought into subjection, and made tributaries by the Maquas [Mohawk]."[7]

Again he writes: "The Maquas, as before mentioned, and who hold most of the others along the river to Fort Amsterdam under tribute."[8]

The most significant recorded payment of bead tribute by the tributary Delaware took place at a Council at White Marsh, May 19, 1712, in which the principal participants were Governor Gookin, the sachems Sasoonan, Scollitchy, Ealochelan, and eleven other Indians. Scollitchy's remarks, with my italic, appear in full below[9]:

> That many years ago being made Tributaries to the Mingoes or 5 Nations & being now about to

[3] COLDEN, CADWALLADER. *The history of the Five Nations of Canada* **1**: xviii. Reprinted A. S. Barnes, New York, 1904.

[4] *An early history of the Nanticoke Indians*, shortly to be published by the Pennsylvania Historical Commission.

[5] *Minutes of the Provincial Council of Pennsylvania* **3**: 204. This work published by the State, 1851–52, was issued in 16 volumes. The first three volumes were printed by Jo. Severns & Co., Philadelphia, the remainder by Theo. Fenn & Co., Harrisburg. Hereafter reference will be made to this source as "Minutes."

[6] *Maryland archives* **16**: 520. Published by Historical Society of Maryland.

[7] DE VRIES, DAVID PETERSON, *Voyages from Holland to America*, trans. H. C. Murphy. New York. 1853. Typed copy in possession of Wilmington Institute Free Library, 92.

[8] *Op. cit.*, 103.

[9] *Minutes* **2**: 546–547.

visit them, they thought fitt first to wait on the Govr. & Council to lay before them the Collecon they had made of their tribute to offer and to have a conference with the Govr. upon it, they therefore laid on the floor 32 belts of Wampum of various figures, and a long Indian pipe called the Calamet with a stone head, a wooden or cane shaft & feathers fixt to it like wings with other ornaments.

This pipe they said, upon making their submissions to the five Nations, *who had subdued them & obliged them to be their tributaries,* those nations had given to these Indians to be kept by them, that at all times thereafter, upon shewing this pipe where they Came, they might be known to be the friend & subjects of the five Nations, and be received by them when they Came amongst them.[10]

Then they proceeded to open their Belts & Declared for what purpose & with what intentions each of them particularly was sent.

The first belt they said was sent by one, who at that time of their agreemt. or submission was an Infant & Orphan, the son of a Considerable man amongst them.

The second Belt was presented by one who was also the son of one then Deceased, but Desired to be taken in & accounted as one of the children to those of the five nations, that he might have clear & free passage amongst them.

The third belt is presented by another Orphan who desires the same.

The fourth by a son of one then living & sends it so large to Express his respect, as that it shall Cover the Pipe or Calamet.

The fifth is to Inform that tho' the principal of the family that sends it be dead, Yet they Continue their Obedience & shew their Intention by this present.

The Sixth sent by another who desires to be regarded as a Child of the 5 Nations.

The seventh by a woman who Desires to be Considered according to her sex; desires peace that she may eat & Drink in Quiet & is always willing to pay tribute.

The Eighth by a woman to the same purpose, desires she may make & keep fires in quiet.

The Ninth by a woman to the same purpose that she may plant & reap in quiet.

The tenth by a woman, desires peace & ease from ye rising of the sun to his going down.

The Eleventh by a woman, Desiring they may always have fair weather & sunshine with ye 5 nations.

The Twelfth by a woman, that a long time ago they made a peace & Desired that it may always be kept strong and ffirm.

The thirteenth by a woman that formerly the five Nations lived amongst us, that tho' now they are at a Distance they may live Quiet.

The fourteenth by a woman Desiring their Houses may be the same.

The fifteenth by a woman, that they are glad they can enjoy peace so quietly to bed and rise in the same manner.

The sixteenth, That formerly some french Inhabited among the five Nations, but a War breaking out, the five nations had Destroyed them, they pray that they may always do ye same.

The Seventeenth that they shall always keep an Open & Clean House for the 5 Nations & be ready to receive them.

The Eighteenth That as they have had Houses among the 5 nations, they Desire they may always have the same privilege.

The nineteenth That they may build their houses firm, as to continue there long, and not be obliged to make them slight, as if they were on all occasions to fly.

The twentieth to the same purpose.

The twenty-first that they build Houses & keep fires without molestation.

The twenty second that they have built Houses, rest securely in them & do not Doubt but they shall have the same liberty.

The Twenty third, That formerly one of the Chiefs of those Nations came down & Dwelt among ym., that they Regarded him always as their superior & one of them.

The twenty fourth That when they arrive, they would fully hear & understand them; and that they may have Liberty to pass & repass in all places.

The twenty-fifth that they may make Racoon & other Blankets to cloathe them & sett Down in them in peace.

The twenty sixth that they are sorry the french should Destroy any of them, for that they take the Loss of any of them to be the Loss of themselves.

The twenty seventh That having heard that in their Warrs they had obtained a victory over the french, they were Glad & Congratulated them upon it.

The Twenty Eight that they are glad their young men have the Privilege of going far from their own habitacons to hunt abroad in peace & that they can return home & Eat & Drink & Enjoy themselves.

The Twenty Ninth that they are Glad they can go in peace to hunt far abroad, that they may return home & Eat quietly meat to make them strong.

The Thirtieth they are Glad they can hunt & bring home relief to their poor relacons.

The Thirty first They are sorry that their Children as well as theirs die: that their Eyes have been shutt up by it, that they could not see the Sun; Desire they may be opened & that all may be cheerful.

The Thirty second They hope they will be pleased with the presents now offered, and that their children will have it in Everlasting Remembrance; *these last 24 were all sent by women*

[10] The Five Nations gave the Nanticokes a belt of white wampum, containing three hands wrought in black beads as a pledge of peace when they made them tributary. It served the same purpose as the pipe did for the Delawares. *Minutes* **2**: 246.

the Indians reckoning the paying of Tribute becomes none but women & children.

From the tone and content of the messages accompanying each string of wampum, it appears that the tribute paid by the Delaware also served as gifts to confirm certain understanding previously agreed upon by the two tribal groups. This entire institution of bead tribute is characterized with undertones and nuances that are lost upon us today, and in view of the scant information, the writers prefer to defer offering further interpretation except to emphasize the references to "submission" in the quotation just cited. There can be little doubt that a conquest occurred, although all writers have not accepted this as fact. For example, Heckewelder wrote: "It is admitted by the Lenape themselves that they and their allies were made women by the Iroquois. But how did this happen? Not surely by conquest or the fate of battle."[11] Certainly the admission by the Delaware chiefs: Scollitchy (in the above quotation), Sassoonan, Tedyuskung, and Beaver, whose statements were previously quoted[12] as well as the depositions herein cited, leaves no doubt that a conquest took place.

Additional evidence can be added from the Five Nations. An Iroquois sachem called The Belt, addressing Governor Robert Morris at a Council held at Carlisle, January 16, 1756—interpreted by Conrad Weiser who understood Mohawk—referred to "the Delawares who were a tribe conquered by and entirely dependent upon them."[13] The next year at Lancaster, Little Abraham, a Five Nations speaker declaimed: "We must inform you that in former times our Forefathers conquered the Delawares and put petticoats on them."[14]

The question that has long perplexed students is why the Five Nations singled out the Delawares and reduced them to womanhood whereas other subjugated tribes merely paid wampum tribute without sacrificing honor or status.

L. H. Morgan, who made the first and classic analysis of Iroquois society, offers a traditional explanation not lacking in plausibility:

> After they [the Delawares] had been subdued and had acknowledged their dependence by sending tributary wampum, they made an inroad upon a western nation under the protection of the Iroquois, notwithstanding their knowledge of the treaty and a prohibition against its infringement. A deputation of Iroquois chiefs went immediately to the country of the Delawares and having assembled the people in council they degraded them from the rank of even a tributary nation. Having reproved them for their want of faith, they forbade them from ever after going out to war, divested them of all civil power, and declared that they should henceforth be as women. This degradation they signified in the figurative way of putting upon them the Gä-kä-ah, or skirt of the female, and placing in their hands a corn pounder thus showing that their business ever after should be that of women.[15]

This statement, if true, would change somewhat the sequence of events in relation to the feminization. It could mean in effect that after their defeat the Delawares, like the other subjugated tribes, merely paid the Iroquois wampum tribute. But, unlike the other tributary nations, they performed a warlike act without the consent of their overlords, and for this breach of contract, they were degraded to the ignominious position of women, their independence forfeited.

It must not be overlooked that Delaware liberation from their position as womenfolk was a product of an era in which white pressures were being exerted on Indian society as part of political intrigue. The Five Nations yielded to English influences, especially through the offices of Sir William Johnson, who was appointed by the Crown to supervise Indian affairs in the Northern

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[11] HECKEWELDER, JOHN. *Customs, manners etc.*: xxvii, Philadelphia, 1876.

[12] Weslager, *op. cit.*

[13] *Minutes* **7**: 3.

[14] *Minutes* **1**: 540. An admission by the Delaware made to Sir William Johnson, July 1756, explains why they were so easily led astray by the French in attacking the English. "We are looked upon as Women, and therefore when the French came amongst us, is it to be wondered they are able to seduce us?" *Documents relative to the colonial history of the State of New York*, ed. E. B. O'Callaghan, **7**: 157. Albany, 1856.

Gideon Hawley, Dec. 27, 1755, quoted the Delaware as follows to Sir William Johnson: "We are women, our uncle must say what we must do, he has the Hatchett and we must do as he says, 'tis true Brother We have not the hatchet. We are poor Women and have got out of temper." *Op. cit.* 48.

[15] MORGAN, LEWIS H. *League of the . . . Iroquois:* 328. New York, 1922.

Department. The Shawnee, Delaware, and a number of western tribes remained within the French sphere of influence. The outbreak of hostilities following Braddock's defeat demonstrated to the English that the Indians held the balance of power, and ultimate victory would come to the army controlling the most powerful Indian allies. Sir William, shrewd in politics and well-versed in Indian affairs, realized that the way to win over the Delaware lay not only through presents, flattery, and settlements of land disputes, but chiefly by according them recognition as a nation of warrior "men." This meant removing their skirts at least in the name of the Crown, hoping that his action would influence the Five Nations to do likewise. Accordingly, on April 17, 1756, in a letter to the Lords of Trade in London after a meeting with Delaware representatives, he wrote: "I concluded this Treaty by Taking off the Petticoat, or that invidious name of Women from the Delaware Nation which hath been imposed on them by the 6 Nations from the time they conquered them."[16]

Sir William's actual speech to the Delaware was as follows: "I do in the name of the Great King of England your father declare that henceforward you are to be considered as Men by all your Brethren the English and no longer as Women, and I hope that your Brethren of the 6 Nations will take it into consideration follow my example and remove this invidious distinction which I shall recommend to them."[17]

As has already been pointed out, the Iroquois eventually extended certain rights of manhood to the Delaware, but only after Tedyuskung, with Quaker support, forced their hand.

Turning for a moment to the Indian concept of the "man" warrior opposed to the "woman" nonwarrior, one must remember that the status of the female differed areally. Among certain tribes her position appears to have been no better than chattel. Elsewhere, she enjoyed a position of influence; for example, "queens" were known to have "reigned" in several Eastern tribes.[18]

In negotiations with colonial authorities, Indian women were frequently allowed a voice, as, for instance, during a meeting with the Shawnee, June 30, 1707. Addressing Governor Evans, "an Indian spoke in behalf of the women: We are concluded in the alliance before spoken of, as well as our men, so we ask the Govrs. Protection and desire the Govr. will accept this present of skins which freely we make him as a Testimony of our kindness." To which the governor replied that he would treat them as friends and sisters."[19]

On June 16, 1710, during a meeting between the Pennsylvania authorities and Tuscarora chiefs, it was recorded: "They signified to us By a Belt of Wampum which was sent from their old Women, that those Implored their friendship of the Christians & Indians of this Govmt. that without danger or trouble they might fetch wood & water."[20]

Several quotations serve to illustrate the high regard for "men" in the guise of warriors.

On July 2, 1754, the famous Mohawk speaker Hendrick addressed Governor James Delacey, urging him to take up arms against the French and saying: "Look at the French, they are Men; they are fortifying everywhere. But we are ashamed to say it. You are all like women, bare and open and without any Fortification."[21]

In 1756 the Iroquois chief Scarroyady urged Governor Morris to declare war on the renegade Delaware and said: "Stand up with your hatchet in your hand, and use it

[16] *Documents relating to the colonial history of New York, op. cit.* **7**: 119.

[17] *Ibid.*

[18] Conrad Weiser wrote that he dined at an Indian town "where an old Seneka Woman reigns with great authority." *Minutes* **5**: 349. Indian "Queens" were recorded for the Conestoga; also for the Choptank and Assateague on the Eastern Shore, see WILLIAM B. MARYE, *Indian towns of the southeastern part of Sussex County, Del.*, Archaeological Society of Delaware, 1940; also *The Choptank Indians, op. cit.* **2**: 5. 1937.

In this connection, it is well known that women enjoyed considerable prestige among the Five Nations. Matrons controlled the succession of chiefs, and, although unskilled in war, their influence was manifest on warriors and chiefs.

[19] *Minutes* **2**: 388.

[20] *Ibid.*

[21] *Minutes* **7**: 79.

manfully. Your enemies have got great advantage by your Inactivity. Show them you are Men."[22]

In the relations between Delaware and Five Nations, there constantly appear references to the "man" warrior versus the woman nonwarrior and the superiority of the former. Canyase, a Mohawk chief, expressed it this way: "We, the Mohocks are *Men*; we are made so from above, but the Delawares are Women, and under our protection, and *of too low a kind to be Men.*"[23]

The Delaware chief Tedyuskung usually referred to the Five Nations as Uncles, and once said, using the singular form: "He is a *Man* and often told us he ought to see Things first and Consider what is to be done."[24]

Accompanying the concept of woman as a nonwarrior was the notion of chastisement as a form of punishment contrasted with the challenge for battle that one would extend to a warrior opponent. Scarroyady reported in 1756 what had passed at Onondaga between the Five Nations Council and two Delaware deputies. He said: "The Six Nations in their Reply expressed great Resentment at the Delawares; they threatened to shake them by the head, saying they were drunk and out of their senses, and assured them if they did not perform what they promised, they would be severely chastized."[25]

Even the white leaders became conscious of the use of the term, and in 1755 Maj. Gen. William Shirley, commander of the English forces in North America, told the Six Nations the following: "The Delaware and Shawnese have always lived under your direction. They looked upon you as their Masters, and you looked upon them as Women who wore Petticoats. They never dared to do anything of importance without your leave, for they knew if they did you would *chastise* them; yet those People now have dared to make war upon your antient Friends."[26]

The concluding reference is of the utmost significance; it appears in the documentary accounts of the intercourse between the Five Nations and Catawba, emphasizing both the concept of the warrior "man" and the recognition of emasculation as the figurative method of degrading a warrior to the status of noncombatant female. So bitter was the state of warfare that obtained between the Iroquois and Catawba that in 1744 the whites exerted every effort to bring about peace. At a treaty council held in Lancaster June 30, commissioners from Virginia and Maryland met deputies of the Six Nations, and the following account was prepared by Conrad Weiser for the records. Weiser's familiarity with Iroquois idiom and philosophy served him in good stead in interpreting the speaker.

> Gachadow, the speaker addressed the whites saying, "You charge us with not acting agreable to our Peace with the Catawbas, and we will repeat truly to you what was done:
>
> "The Governor of New York at Albany in behalf of Assaraquoa [meaning Big Knife, the name applied by the Mohawk to the Governor of Virginia] gave us several belts from the Cherickees and Catawbas and we agreed to a Peace if those Nations would send some of their Great Men to Us to confirm it face to face, and that they would Trade with us, and desired that they would appoint a time to meet at Albany for this purpose, but they never came.
>
> "We then desired a Letter might be sent to the Catawabas and Cherikees to desire them to come and confirm the Peace. It was long before an Answer came, but we met the Cherikees and Confirmed the Peace, and sent some of Our People to take care of them untill they returned to their own country.
>
> "*The Catawbas refused to come, and sent us word that we were but women, that they were men and double men for they had two P——s; that they would make Women of Us,* and would be always at War with us. They are a deceitful People. Our Brother Assaraquoa is deceived by them; we don't blame him for it, but we are sorry he is so deceived."[27]

So bitter, in fact, was the feeling between them that "the Catawbas had declared to the Tutulows and Cherakees that they would never sue for Peace with the Six United Nations, but that they would fight them whilst there was one of them alive, and after their death their very Bones shall fight the Six Nations."[28]

The writer submits that the citations

[22] *Minutes* **7**: 297.
[23] *Minutes* **7**: 297.
[24] *Minutes* **8**: 200.
[25] *Minutes* **7**: 71.
[26] *Minutes* **7**: 22.
[27] *Minutes* **4**: 721.
[28] *Minutes* **5**: 473.

offered in the foregoing discussion, appended to those presented in the previous paper, constitute overwhelming evidence in support of the premises enumerated at the beginning of this essay.

The writer acknowledges the assistance of Dr. Frank G. Speck and Dr. William N. Fenton in the preparation of the manuscript of this paper but in no way commits them to the ideas herein expressed.

ETHNOLOGY.—*Notes on a Cherokee migration story.*[1]

JOHN WITTHOFT, University of Michigan. (Communicated by W. N. FENTON.)

A Cherokee tradition of migration from the Ohio Valley, mentioned by Adair and Haywood,[2] would suggest a recent separation of the Cherokee from the northern Iroquois and possible identification of the Cherokee with specific archeological complexes in the Ohio area. Cherokee ethnographic data indicate, however, that Cherokee culture is essentially Southeastern, not a recent importation; available data on Cherokee archeology suggests that the Cherokee have been long resident in their present area. Cherokee culture seems to show closest relationship to Creek. Thus it would be extremely desirable to evaluate Haywood's and Adair's suggestion and gather further data relating to Cherokee traditions of tribal origin and movement, especially in view of the Delaware traditions about the Talligewi.

While engaged in field work among the Eastern Cherokee of Qualla Reservation, North Carolina, at several periods during the past two years, I attempted to gather some data relating to this question. I could find no vestiges of any such migration legend or of any consciousness of Cherokee relations to the northward. Traditional material relating to the Iroquois was sparse, and all pertained to the period of the Iroquois-Cherokee wars. The Iroquois are known as ani' sɑnáká (Seneca People), probably because the Seneca were the Iroquois group best known to the Cherokee. Cherokee informants who had met Iroquois were conscious of lexical cognates in the language, but had little sense of the language relationship.

The Cayuga form of the general Iroquois name for the Cherokee, as given by Deskaheh (Alex General), of Six Nations Reserve, Ontario, Canada, is wiya'tąkehoná, "people in the hollow or valley." (Compare Mohawk Oyata'ge'ronno^{n}', Onondaga Oyata'ge'he'no^{n}', Seneca Oyada'ge'o'ñno^{n}'—"cave or burrow dwelling people," etc. J. N. B. HEWITT, *The name Cherokee and its derivation*, Amer. Anthrop., n.s., **2**: 591–593. 1900.—W.N.F.)

Work with two of the older and more conservative informants, Will West Long and Mollie Sequoyah, gradually brought out the fragments of a migration tale that they had heard in their childhood. According to this tradition, the Cherokee had come into their present area from a southwestern direction. Mollie thought that there might still be Cherokee back there somewhere—perhaps in South America. The immigrating Cherokee destroyed and displaced a race of giants, called, according to Will, tcikamoká. These giants were the people who used as tips for their arrows the large projectile points found by archeologists in this area. Will recognized two basic groups of Cherokee: the original group, from which his people split off before migration, called anig'a'du·'wagi'', "confederated people"; and the Cherokee who came to the East, ondą·se·lagi'', "they separated from the bunch." The second group preceded the first into the East, and the two divisions seem to represent the middle and Western Cherokee dialect groups.

The name tcikamoká is apparently not a Cherokee word, and is doubtless a garbled reference to the eighteenth-century Cherokee-Creek-Shawnee renegade towns on the lower Tennessee River, known as Chickamauga or Nickajack. Indians from these towns came to the Qualla area in the early

[1] Received March 17, 1947.

[2] ADAIR, JAMES, *The history of the North American Indians:* 227. London, 1775. HAYWOOD, JOHN, *Natural and aboriginal history of Tennessee:* 226. Nashville, 1823.

nineteenth century, and some Qualla Cherokee still carry Nickajack as part of a personal name (Nickajack George, for example).

When questioned about the other names, Will said that Kadu'wa'' was an old name for the Cherokee and noted that the large fertile bottom at Governors Island, N. C., about 8 miles east of the present reservation, is still known as kadu'wa?hi', "place of confederated people." This bottom contains several large archeological sites. Will also noted that this word was related to gadu'gi'', the name of the Cherokee mutual aid and work society. Speck and Schaeffer have done a thorough study of this society, and considered it as a survival of a basic Cherokee-Iroquois institution[3]; I should suggest that it represents the surviving structure of a Cherokee town, its political function usurped by an introduced council and constitutional government. We may note that kadu'wa' is the name by which the Cherokee were known to many of their northern neighbors, especially the Delaware, Shawnee, and other Algonkian peoples.[4]

Will's second Cherokee group name supplies us with another possible etymology for the name Cherokee, a form that requires further checking but that seems to permit analysis without distortion of the Cherokee elements. Another, and perhaps the most convincing interpretation for this name, is not Cherokee at all and would derive the name from the Creek, Celok'okálke,"people of another language" (celokálki, "Cherokees").[5] This idea has already been suggested by Swanton[6] and would indicate that the Creek name by which the Cherokee were first known to Europeans became the general name for them in the Southeast, and was soon accepted even by the Cherokee themselves; names for other tribal groups have come into existence after a similar fashion.

Quite possibly our two early references to Cherokee migration from the Ohio Valley pertain to Cherokee expeditions into that area during the Colonial Period. The recently collected tale is apparently a much abbreviated version of the Creek migration legend, and appears to be the story which motivated Sequoyah to journey into Mexico in search of a Cherokee group in the legendary homeland, to die in San Fernando, Tamaulipas, in 1843. Such an association would indicate that it is not a recent accretion to Cherokee folklore brought to Qualla Reservation by Creek stragglers drawn to a refuge area. Sequoyah's early biographer, George Foster, tells us:

> One bright morning, in the year 1840, there started out in the Arkansas Cherokee Nation, one of the most peculiar expeditions in search of knowledge that the world has ever known. First and foremost in the company we recognize our friend, Se-quo-yah. He had heard the ancient tradition, that a part of his people were in New Mexico, having been separated from them, some time before the advent of the white race, and somewhere there, he expected to find a missing link in the linguistic chain. And for this purpose, he started westward.[7]

Gabriel refers to the same tale in his account of Sequoyah's death:

> But still that strange discontent within him was not quieted. It became a yearning to achieve the unattainable. It robbed his declining years of peace. An old, half-forgotten tradition of the Cherokees told of a band which in antiquity had wandered into the distant land of Mexico and had never been heard of since. Death caught up with Sequoyah in the little Mexican settlement of the long lost Cherokees—still striving to make dreams come true.[8]

[3] SPECK, FRANK G., and SCHAEFFER, CLAUDE E., *The Mutual-aid and volunteer company of the eastern Cherokee: as recorded in a book of minutes in the Sequoyah syllabary, compared with mutual-aid societies of the northern Iroquois.* Journ. Washington Acad. Sci. **35**: 169–179. 1945.

[4] Dr. Frank G. Speck informs me that the Delaware cognate, Kadu'ha, means cold, shivering.

[5] LOUGHRIDGE, R. M., and HODGE, D. M., *Muskogee dictionary:* St. Louis, 1890. The Yuchi is tsala''ki, plural tsala''kiha (Frank G. Speck). The Cherokee equivalent is tsala'ki', plural ani'tsala'ki'.

[6] SWANTON, JOHN R., *The Indians of the Southeastern United States.* Bur. Amer. Ethnol. Bull. **137**: 217. 1946. SWANTON, *in* Webb, Wm. S., *An archaeological survey of the Norris Basin, in eastern Tennessee.* Bur. Amer. Ethnol. Bull. 118: 204–205. 1938.

[7] FOSTER, GEORGE E., *Se-quo-yah:* 155. Philadelphia, 1885.

[8] GABRIEL, RALPH HENRY, *Elias Boudinot and his America:* 105. Norman, Okla., 1941.

BOTANY.—*The ecology of the wild kidney bean* Phaseolus polystachios (*L.*) *BSP.*[1]

H. A. Allard, Arlington, Va.

In view of the great value of beans as a human food crop all over the world, and the increasing interest in the genetics of the various members of the group in problems of breeding for disease resistance and insect tolerance, and increased productivity and climatic adaptation, it seems advisable to bring together all our knowledge of the wild bean of the eastern United States so far as possible.

According to Small (1913) three species of *Phaseolus* occur in the eastern United States, *P. sinuatus* Nutt., *P. smilacifolius* Pollard, and *P. polystachios* (L.) BSP. The first two species are Florida or Gulf coast species, occurring in dry pinelands and hammocks. *P. polystachios* extends from Florida northward to Canada and Minnesota and westward into Louisiana and Nebraska. I know nothing of the behaviors and relationships of *P. sinuatus* or *P. smilacifolius*, whether the cotyledons are epigean as in the case of the beans of *P. vulgaris*, or hypogean as is the behavior of *P. polystachios*, as established by Harry A. and Howard F. Allard (1940). This would be a very interesting point to consider, however, in determining the relationships of these southern species.

Following are the distinguishing botanical characters of *Phaseolus polystachios:*

A twining, finely pubescent, herbaceous perennial with tuberous root; leaves 3-foliolate, the leaflets roundish-ovate; flowers in numerous peduncled, loosely flowered racemes, 4 to 10 inches long or more, purplish-blue, small, showy, produced from midsummer till fall; style bearded lengthwise on the upper surface; keel spirally coiled; pods somewhat curved, drooping, 2.5–5.0 cm long, 5–8 mm wide; beans 4 or 5, round reniform, 3–5 mm long, dark brown, finely speckled with black; cotyledons hypogean. A plant of thickets and woodlands on the Coastal Plain and in the Piedmont area.

HABITAT RELATIONS OF PHASEOLUS POLYSTACHIOS

Phaseolus polystachios is a thicket and woodland plant in its natural habitat and can not compete with grassland or the broomsedge habitat of open fields and pastures. Even if it were adapted to such open conditions, the trampling and browsing of stock would probably lead to its ultimate extermination here, for it is a delicate climbing plant. In northeastern Virginia, I have found it scattered over the steep rocky slopes of Bull Run Mountain, but it is far from common here. In truth I have never found it common anywhere in its range. In the Bull Run area it is usually found on the warmer more protected east slopes. It is much more common on the wooded slopes of the granitic knobs of Big Cobbler, Rattlesnake, and Oventop, all outliers of the Blue Ridge Province. I have never found it on the higher ridges of the Blue Ridge or the Alleghenies.

According to Small and Carter (1913) it occurs on sandstones, shales, and schists in Lancaster County, Pa. In the Bull Run area it occurs on the drier ridges of the Cambrian quartzites, which in weathering produce a sterile, porous, sandy type of soil. I have never quite understood the restricted distribution of this plant on the Bull Run ridges and its strong predilection for the upper slopes just below the outcropping, steeply tilted sandstone ledges. This relation holds throughout the length of these north-south ridges. One ecological relationship is very pronounced, however: this bean does not tolerate anywhere heavy, wet soils or heavy shade. The soils of the upper slopes of the ridges are not only drier, thinner, and always thoroughly drained, but the character of the forest is more open here, and better illumination obtains from the fact that it is dominated by a less vigorous stand of chestnut oaks. This combination of favorable factors may be responsible for the establishment of the wild bean in this particular zone. In favorable woodland situations there is a noticeable tendency for the plants to occur in colonies. This is due to the fact that when a perennial rootstock has become established the seeds produced tend to fall near the parent plant, and the germination of these year after year favors the development of colonies.

[1] Received April 14, 1947.

These colonies gradually enlarge as the seeds from the twining, scrambling aerial stems of the peripheral plants reach more outlying areas.

Although in Gray's *Manual* (1908) the characterization of the genus *Phaseolus* states that the fleshy cotyledons rise out of the ground nearly unchanged in germination, L. H. Bailey (1935, p. 458) says that the bean differs from the pea in being epigeal in germination that is pushing the cotyledons above the ground. I have found that this is not true for the wild kidney bean. As previously stated the cotyledons have an hypogean existence, as in the case of the cultivated Scarlet Runner bean *Phaseolus multiflorus* Willd.

Under favorable woodland conditions where there is an abundant, protective, loose, forest litter and a layer of rich leaf mold, the wild bean becomes perennial, and develops a large, tough rootstock very deeply rooted in the loose, porous soil. This rootstock may become an inch or more in diameter at the crown and produces here many buds at the leaf-mold level. Some of these rootstocks appear to have survived for many years, and thick fleshy roots have penetrated the soil for 15 to 18 inches. The wild bean grows vigorously in well-drained garden soil, but owing to the wet, soggy condition of such soil in winter, the rootstocks do not well survive the winter here.

The wild bean is a tuber-producing plant, storing up an abundance of reserve material in good-sized spindle-shaped tubers, only a portion of which is used in the annual formation of the slender aerial stems. I did not realize that tuber formation was such a pronounced characteristic of this species until I had occasion to dig up some rootstocks in the spring of 1947 in the Bull Run Mountain area. In this respect, as in the hypogean behavior of the cotyledons, the wild bean shows closer affinities with the Scarlet Runner assemblage, *Phaseolus multiflorus*, than with the common field and snap beans *Phaseolus vulgaris* L.

LENGTH-OF-DAY BEHAVIOR

I have studied the length-of-day behavior of the wild bean rather fully, both in localization experiments and on various lengths of day (Allard, 1938). In the localization tests one stem of a rootstock was kept under short-day conditions of 10 hours (from 6:00 A.M. to 4:00 P.M.) each day, while another stem from the same plant was exposed to the full day of Washington, D. C. The average length of day from March 21 to September 21, through the longest days of the summer solstice (near 15 hours from sunrise to sunset), is about 13 hours, and from April 15 to September 2 the length of day exceeds 13 hours. The stem given only 10 hours of light each day grew but little beyond the original height, 5 inches, when the tests began, and finally died late in summer without budding. The outside stem experiencing the full day grew very vigorously as a climber, attaining a height of 3–4 feet; buds appeared on July 21 and flowers August 2. This portion of the plant was very floriferous and produced many pods (Allard, 1938a, fig. 2).

Further photoperiodic studies were made subjecting the entire plant to constant lengths of day with a series of lengths of day arranged as follows: 10, 12, 12½, 13, 13½, 14, 14½ hours, and full day. These tests demonstrated that flowering was most prolific on intermediate lengths of day from 13½ hours through 14 hours, 14½ hours, and the full length of day.

Plants receiving only 10 hours of daylight each day never flowered. One flower only appeared on the plants afforded 12 hours of daylight. Flowering was more vigorous with 13 hours of daylight each day, but some of the blossoms even here were cleistogamous.

The twining habit did not develop until the plants were afforded 13½ hours of daylight but remained low, bushy, and dark green. On lengths of day shorter than 12½ hours the plants showed the dwarfed, sterile, winter behavior, with thickish, dark-green, rugose leaves and short thickened stems. These plants barely survived the summer and remained practically in a state of vegetative dormancy for many months.

The normal twining habit of the wild bean is entirely dependent upon length of day, and this response does not become evident until a length of day between 13½

and 14 hours is experienced. Until a vigorous twining habit has developed the plants produce few flowers. Vigorous flowering is not strictly correlated with the twining habit, however, since an excessively long day of 16-18 hours, obtained by artificial light, again tends to inhibit flowering, although a vigorous twining behavior is maintained. These relations are clearly shown by Allard (1938a, fig. 5). In figure 6 (Allard, 1938a) the growth of plants is shown under 12 hours and 12½ hours of light daily. The 12-hour plants never flowered, but one plant of the 12½-hour group flowered on July 27. The plants in both groups were low and bushy, with the exception of one plant experiencing 12½ hours of light daily, which produced a short runner. As a matter of fact the plants were exceptionally bushy in habit of growth under these shorter-day lengths. The pods and seeds on the 12½ hour plants were exceptionally large for the species, however, some of the pods measuring 5.8 cm in length from the tip of the beak to the calyx, with a maximum width of 11 mm.

It is evident that the wild bean is a long-day type of plant, i.e., it flowers on a lengthening day. Lengths of day below 12½ hours not only inhibit twining, so that the plants become low and bushy, but also prevent flowering. Such plants behave as if they were in a more or less quiescent or dormant condition. This short-day behavior limiting flowering and seed production would exclude this bean from the Tropics and adapt it to more northern latitudes, until cold and perhaps excessively long days became the limiting factors governing its survival.

This bean is probably a northern derivative of the more southern bean assemblage, for in its present form it could not have originated in the Tropics, nor could it survive there with its present characteristics of behavior.

Stem elongation or twining behavior is an interesting growth response in relation to length of day, and whether induced by long or by short photoperiods, depends entirely upon the species. The wild bean *P. polystachios* becomes bushy as the days are shortened. The Jack bean, *Canavalia ensiformis* (L.)DC., becomes a pronounced twiner on the same short days that produce dwarfed plants in the wild bean. The wild bean becomes a climber on an increasing length of day, while the Jack bean becomes bushy on a lengthening day. The common garden beans, *P. vulgaris*, and *Stizolobium deeringianum* Bort., as in the case of the wild bean, completely reverse these length-of-day relations of *Canavalia*, but greenness of the leaves is not noticeably changed. (Allard and Zaumeyer, 1944.)

Allard and Garner (1940) have shown that the Medellin bean, F. P. I. No. 46145 *Phaseolus coccineus* L. (*P. multiflorus*), flowered best on short days, with a remarkable enlargment of roots to produce tubers when the plants experienced photoperiods of 10 hours. This flowering behavior shows that this particular bean is eminently adapted to the short tropical days.

Some strains and varieties of tropical beans are not only short-day plants in their flowering responses but show marked tendencies to produce pronounced underground tubers under short-day conditions. This behavior was shown in the case of a tropical South American bean (*Phaseolus multiflorus*). Plants exposed to 10 hours of daylight throughout the summer, and to the shorter winter days in the warm greenhouse, became strongly tuberized (Garner and Allard, 1923, p. 893, pl. 6). Other plants of this bean exposed to the full day of summer, and to electric light during the winter in the greenhouse to extend the length of the natural day, never flowered and never produced tubers. Twelve hours of light in summer and the natural winter length of day produced less tendency to tuberize than the 10-hour plants. Tuberization of these tropical beans appears to be a response to the short days, just as in the case of the wild bean. In the latter, tuberization appears to take place on the shortening days of late summer and autumn.

CHROMOSOME NUMBER OF PHASEOLUS POLYSTACHIOS

Eleven species of beans of the genus *Phaseolus* are known to be more or less generally grown in various parts of the world. As reported by J. Kamakami (1930), all these have 22 chromosomes as the *2n*

number. Among these are *Phaseolus acutifolius, P. angularis, P. aureus, P. coccineus, P. lunatus,* and *P. mungo. Dolichos lablab* has 22 (*2n*) chromosomes.

The chromosome number of the wild bean was determined by Howard F. Allard (1940), and the *n* number of the pollen mother cells was found to be 11; the somatic (*2n*) number, then, is 22, as in all other species of *Phaseolus* reported upon. These chromosomes are of small size in the wild bean. It would appear that from the constancy of chromosome number in the genus *Phaseolus,* the genus is rather stable in this respect, or perhaps of more recent evolution. The genus as a whole appears to be of tropical and warm climate origin, since the center of distribution is within the Tropics. Such species and varieties as are now grown in higher extratropical latitudes are either day-neutral sorts or those with high critical limitations with respect to length of day which favors flowering in high latitudes.

ENEMIES

The wild bean may flower profusely, but often very few pods are found on the flowering panicles. In the green state a tiny native weevil rather freely parasitizes the pods. In my garden it seemed to me that the Mexican bean beetles were less inclined to attack this bean, but much more study is needed to establish this relationship fully.

As a food plant the beans are too small to be of any value to human beings, and there is no evidence that even the eastern Indians ever made use of this bean, owing to its scarcity. The weight of 100 mature beans harvested in the Bull Run Mountain area was only 6.8 grams.

I am informed by Dr. Volney H. Jones, of the Museum of Anthropology of the University of Michigan, that beans of some race of this species have been found fairly numerous in bluff shelters in the Ozark region of northwestern Arkansas and southern Missouri, and were apparently used for food by the early aborigines. These beans appear to be a larger-seeded race than those of our eastern assemblage, according to Dr. Jones.

It would appear that out wild bean is a plant of considerable interest in many respects—in its various photoperiodic responses, in its taxonomic relationships, and in the possibilities of useful genetic combinations in crosses with some of our useful varieties and species of cultivated beans.

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ENTOMOLOGY.—*New eumolpid beetles from the West Indies.*[1] DORIS H. BLAKE, Arlington, Va.

Described herein are three new species of beetles of the genus *Metachroma* Dejean (Coleoptera: Eumolpidae) from Puerto Rico that have come to light in the collection of Stuart T. Danforth recently acquired by the Museum of Comparative Zoology; three new species of *Metachroma* collected by P. J. Darlington in Oriente Province, Cuba; and two new species of *Alethaxius* Lefèvre, one from Isle Tortue off Haiti, collected by Mr. and Mrs. E. C. Leonard, and the other collected by J. Acuña at Moa, Oriente Province, Cuba.

Metachroma ensiforme, n. sp.
Fig. 1

About 3 mm in length, oblong-oval, shining pale yellow with reddish-brown markings on thorax and elytra; thorax finely and densely punctate except on the sides; elytra with only vestiges of striate punctation except for the strong punctures below the basal callosity and in the intrahumeral sulcus. Aedeagus unusually long and slender.

Head with interocular space less than half its width. Occiput and vertex with a faint obsolete punctation tending to give a wrinkled appearance; a deep groove about base of antennal sockets and connecting across lower front. Antennae pale with the outer joints slightly deeper in color and thicker, extending below the humeri. Prothorax not twice as broad as long, with arcuate sides and a small acute tooth at each corner; an indented line running along basal margin and behind the eyes anteriorly; a slight depression over the head; surface thickly punctate except about the edges; yellowish brown with a deeper reddish-brown median area. Elytron with deep intrahumeral sulcus and an indented line across the base and down along the suture; punctation indistinct except in intrahumeral sulcus and below the basal callosity; yellow-brown with two short reddish-brown vittae extending over the basal callosity and a diagonal stripe from about the middle of the side down to the suture, forming on the combined elytra a wide open V; in poorly marked specimens only traces of these markings. Body beneath and legs pale yellow brown, shining, femora not toothed, claws with a long basal tooth. Length 2.7–3.1 mm; width 1.4–1.6 mm.

Type male and 4 paratypes, M. C. Z. no. 27677; 2 paratypes, U.S.N.M. no. 58356.

Type locality.—Pico Turquino, south side, 1,000–5,000 feet elevation, Oriente Province, Cuba, collected in June 1936 by P. J. Darlington.

Remarks.—The long, sword-shaped (although curved) aedeagus is unlike any that I have seen in this or related groups.

Metachroma imitans, n. sp.
Fig. 2

Length approximately 2.5 mm, ovate, shining deep reddish brown with paler legs and antennae; head and prothorax distinctly punctate; elytral punctation not very distinct over basal callosities and in apical half.

Head with interocular space nearly half as wide as head; shining and lightly punctate above, more coarsely and densely so between the eyes and in lower half; frontal tubercles indistinctly marked; no groove between the eyes. Labrum paler but jaws edged with deep brown. Antennae pale; second joint nearly twice as long as third; distal joints a little thicker and deeper in coloring; extending well below the humeri. Prothorax not twice as wide as long, with arcuate sides and a small acute tooth at each corner and an indented line along base and extending from the sides up behind the eyes on the anterior margin; surface shining deep reddish brown but not quite so dark over the head and moderately closely and distinctly punctate; a slight depression behind the head. Elytra very shiny deep brown; humeri well marked; a depression behind the basal callosity; an indented line of punctures along basal margin and down along the suture to the apex, otherwise lines of punctures not very distinct their entire length, nearly vanishing over the basal callosities and behind the middle; the punctures large in the intrahumeral sulcus and in depression below the basal callosities. Body beneath and legs paler, shining; femora without toothing; claws toothed. Length 2.3–2.5 mm; width 1.2 mm.

[1] Received March 21, 1947.

Type male and 1 paratype (female), M. C. Z. no. 27678.

Type locality.—Aguadores, Oriente Province, Cuba, collected June 6, 1936, by P. J. Darlington.

Remarks.—This is very close to a species in the National Museum collected at Cayamas, Santa Clara Province, Cuba, by E. A. Schwarz and labeled by him as *M. puncticollis* Suffrian, a name later changed in the Junk Catalogue to *M. cubaecola* Clavareau. The punctation is not quite so dense or distinct on the thorax and is less marked on the elytra. The aedeagus of the Cayamas species is peculiar in being forked like a claw at the tip, in this respect resembling at least one other species of *Metachroma* from North America. The aedeagus of *M. imitans*, in contrast, is of the ordinary sort, broad with an acute tip.

Metachroma metrium, n. sp.
Fig. 3

About 4 mm in length, broadly oblong-oval shining yellow-brown with dark markings on the occiput, thorax, and elytra; on each elytron a spot on the basal callosity, three placed transversely below the basal callosity and two or three paler ones slightly below the middle of the elytron, one on the edge and the other on the side; punctation of elytra indistinct in apical half.

Head with interocular space not half width of head; eyes large; occiput and front obsoletely punctate and somewhat wrinkled, yellowish with a broad dark band extending down front, faint indication of frontal tubercles and a slight depression between the eyes. Antennae extending to the middle of the elytra, the six distal joints deeper in color and thicker. Prothorax not quite twice as broad as long, with an acute tooth at each corner and slightly arcuate sides; surface mirror smooth, impunctate, yellow-brown with dark brown or piceous irregular markings on each side. Elytra ,with small humeri, a short intrahumeral depression, and not pronounced basal callosities; striate punctation rather fine except below the basal callosities and indistinct in apical half; shining yellow-brown with a dark streak in the middle of the base, three small spots across below this, the outer one on the edge, and two or three larger, less distinct spots, slightly below the middle. Body beneath and legs pale, the femora with a darker spot at the apical constriction and darker along the sides of the tibiae. No indication of toothing on femora; a short basal tooth on claws. Length 4.1–4.3 mm; width 2.2–2.4 mm.

Type male and 1 paratype, M. C. Z. no. 27679; 1 paratype, U.S.N.M. no. 58358.

Type locality.—Villalba, Puerto Rico, collected June 21–28, 1934, by C. M. Matos (Stuart T. Danforth Collection).

Remarks.—In shape and markings this species resembles somewhat *M. cinctipes* Blake, from the Dominican Republic, but that species has a larger prothorax and the elytral punctation is more distinct.

Metachroma xanthacrum, n. sp.
Fig. 4

Length 4.5 mm, oblong-oval, shining piceous with antennae, legs, margin and apex of elytra, and apex of abdomen pale; head and prothorax very finely and sparsely punctate; elytra with only the sutural striae entire, the short rows of punctures below basal callosity becoming progressively shorter toward the sides.

Head with interocular space less than half its width; eyes large; occiput and front with obsolete punctation producing a wrinkled appearance; frontal tubercles faintly outlined; no groove between the eyes, lower front deep reddish brown, also a pale spot near eye on vertex. Antennae pale, extending below humeri; second joint longer than third; five distal joints thicker and hairier than basal joints. Prothorax not twice as wide as long, with rounded sides; a tooth at each corner and an indented line along basal margin and behind the eyes anteriorly; surface very smooth and shining, a few indistinct scattered punctures; piceous except a light reddish-brown area along anterior margin. Elytra with small humeri and a basal callosity with a depression below, in which there are short rows of coarse punctures; the sutural striae alone reaching apex and the other striae becoming progressively shorter toward the side; dark piceous except along pale sides and broadly pale apex; two reddish spots on each side of scutellum at base. Body beneath deep reddish brown with paler apical segments of abdomen; legs pale except at the constriction near the apex of femora and along sides of tibiae at base. All femora weakly toothed; claws with long basal tooth. Length 4.5 mm; width 2.4 mm.

Type female, M. C. Z. no. 27680.

Type locality.—Loma del Gato, Cobre Range, Oriente Province, Cuba, at about 3,000 feet elevation; collected July 3–7, 1936, by P. J. Darlington.

Remarks.—This species lies between *M. adustum* Suffrian from Cuba and *M. wolcotti* Bryant from Haiti. It resembles the former in general coloration, having a pale apex to the elytra, but lacks the distinct elytral punctation in which the rows of punctures are entire. In this respect it resembles the Haitian species *M. wolcotti*, which is entirely dark, with dark legs and elytra. *M. terminale*, described by Horn from Florida, is identical in outward appearance with *M. adustum* and was considered the same by E. A. Schwarz, and I synonymized the two at an earlier date. Dissection shows a slight difference in the aedeagus. Whether this indicates specific differentiation is a question only to be decided by breeding. The aedeagus of *M. wolcotti* is very similar to these two and drawings are here given of all three (Fig. 8). Unfortunately the only specimen known of *M. xanthacrum* is a female. These species are all very closely related and show the effects of isolation in the development of their small differences.

Metachroma fenestratum, n. sp.
Fig. 5

About 3 mm in length, oblong, lustrous yellowish or reddish brown with a dark vitta on each side of the thorax and a broad dark marking on the basal callosity of the elytron and below along the suture, and a fainter band running from about the middle of the side diagonally across to the suture; head and thorax indistinctly punctate; elytra with large striate punctures for a short distance below the basal callosities and in the intrahumeral sulci.

Head with interocular space about half its width, smooth, in some specimens indistinct wrinkles as of obsolete punctures, the groove between the eyes and about antennal sockets deep. Antennae extending to the middle of the elytra; second joint longer than third and five distal joints heavier and with dark apex. Prothorax rather narrow, considerably less than twice as broad as long, with curved sides and a sharp tooth at each corner; an indented line along basal margin and anteriorly behind the eyes; surface very shiny, only indistinctly and sparsely punctured; deep reddish brown with a dark stripe on either side. Elytra with small humeri and basal callosities and a deep intrahumeral sulcus; a line of indented punctures along base and down suture, and short rows of large punctures below the basal callosities and in the intrahumeral grooves, these rows becoming indistinct before the middle; surface very smooth and shiny; pale yellowish brown with dark markings in the middle of the base and below for a short distance along the suture, a darker band starting from the side at the middle and extending diagonally across to the suture, but becoming paler. Body beneath shining yellowish or reddish brown. Femora not toothed; claws with a long basal tooth. Length 2.8–3 mm, width 1.4 mm.

Type male and 1 paratype, M. C. Z. no. 27681; 1 paratype, U.S.N.M. no. 58357.

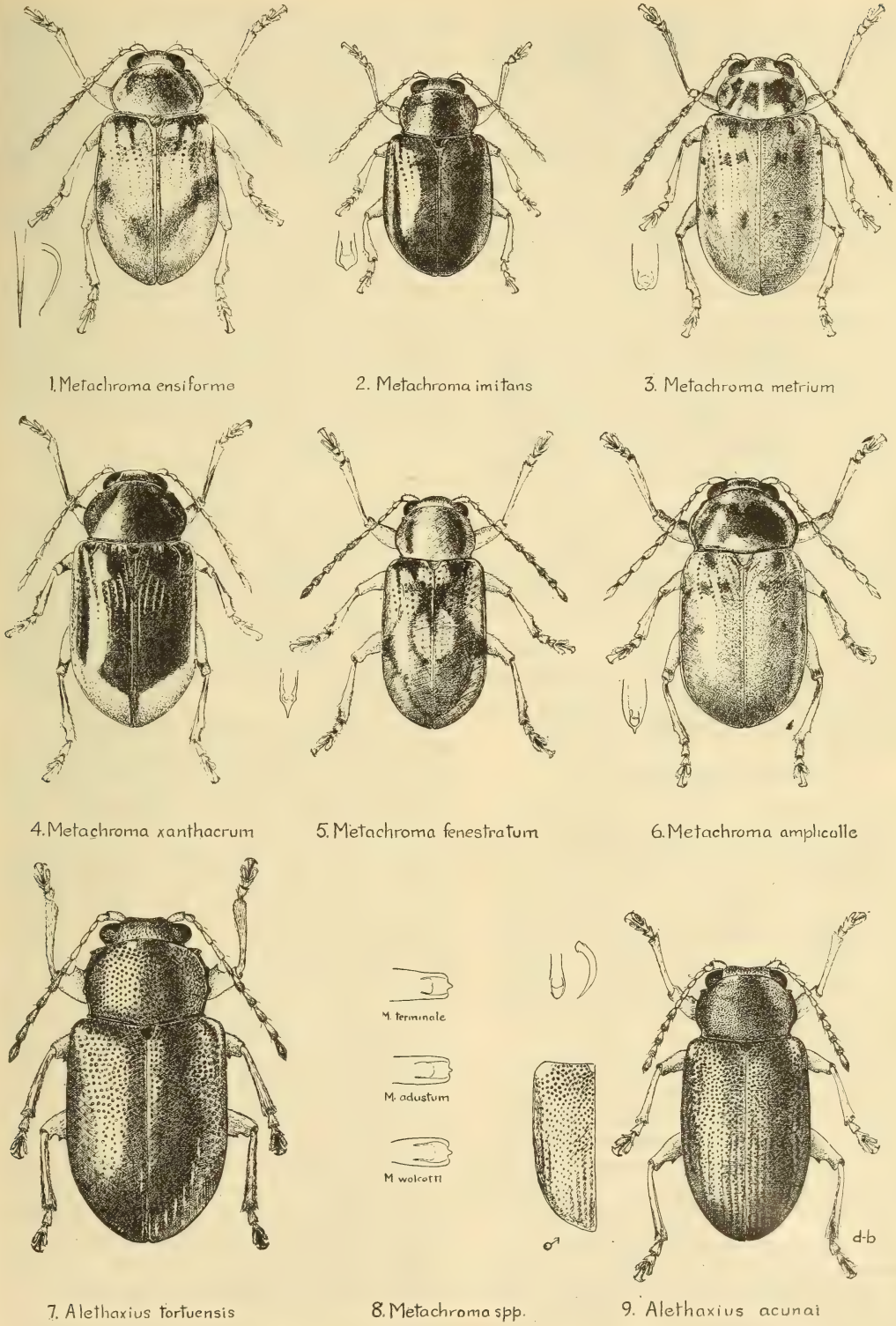
Type locality.—Yauco, Puerto Rico, collected June 15, 1934, by C. M. Matos (Stuart T. Danforth Collection).

Remarks.—This is an unusually narrow species with markings similar to *Metachroma ensiforme*. The aedeagus, though not so narrow and sword-shaped, has a long acute tip but is much broader and shorter behind the tip.

Metachroma amplicolle, n. sp.
Fig. 6

About 3 mm in length, oblong, shining, yellow or reddish brown with a dark spot on the occiput, a broad irregular band across pronotum, and a small spot at base of the basal callosity and below in the depression and on the edge, and in some specimens two spots at the middle, one on the side and the other on the edge; pronotum almost impunctate; elytra with striate punctation entire only in the two rows next to the suture. Thorax almost as broad as elytra.

Head with interocular space less than half its width; eyes large; occiput and front distinctly but finely punctate, more coarsely in lower front; a median line between the tubercles and a groove about antennal sockets, a slight depression between the eyes; yellow-brown with a broad dark band down front. Antennae pale, extending to the middle of the elytra, the five distal joints heavier. Prothorax large and about as wide as elytra, not twice as broad as long, the sides arcuate; an indented line across the base and almost across the anterior margin,



FIGS. 1–9.—New species of West Indian eumolpid beetles

a sharp tooth at each corner; surface very smooth and often impunctate, in some specimens a very fine punctation; reddish brown with a large transverse dark band, in paler specimens this band broken into two large spots. Elytra with small humeri and short intrahumeral sulci, a slight depression below basal callosities; punctation not very coarse and only the two lines next to the suture entire, the other rows of striate punctures becoming indistinct toward the apex; yellowish or reddish brown with piceous markings over the basal callosity and below humerous on the edge of the elytron, in darker specimens a spot on the side and one on the margin halfway down the elytra. Body beneath and legs pale and shining. No teeth on femora; in darker specimens a dark ring about constriction of femora near the apex; claws toothed. Length 2.7–3.4 mm; width 1.4–1.6 mm.

Type male and 3 paratypes, M. C. Z. no. 27682; 1 paratype, U.S.N.M. no. 58359.

Type locality.—Guanica, Puerto Rico, collected June 25, 1934, by C. M. Matos (Stuart T. Danforth Collection).

Remarks.—In its unusually heavy prothorax this species resembles *M. cinctipes* Blake from the Dominican Republic. It is a considerably smaller species with less distinct punctation.

Alethaxius tortuensis, n. sp.
Fig. 7

Length 4 mm, broadly oblong, shining, densely punctate, deep bronzy dark green with a bluish luster over the prothorax; legs and antennae and undersurface reddish brown. Thorax with two undulating teeth on the sides; all femora toothed; female without noticeable elytral rugosities, the punctation on the sides somewhat coarser and with a slight tendency toward costation in apical half.

Head with fine wrinkles radiating from the vertex and on back of head becoming striate punctation; lower front coarsely and not very densely punctate; deep shining greenish black, the mouth parts brown. Antennae reaching well below the humeri, the five distal joints thickened and with the apical half dark. Prothorax not twice as broad as long, with a prominent tooth at apical angle, two rounded teeth on the margin, and a small tooth at basal angle; basal margin sinuate; surface shining, densely punctate in basal half, the punctures in apical half becoming striate and less dense, with the smooth intervals between them a little raised; except for these costae and somewhat larger lateral punctures, little trace of other rugosities. Body beneath deep reddish brown, lightly pubescent. Legs with all the femora sharply toothed. Length 4 mm; width 2 mm.

Type female, U.S.N.M. no. 58360.

Type locality.—Bassin Bleu, Isle Tortue, north of Haiti, collected in April 1929 by E. C. and G. M. Leonard.

Remarks.—This is the broadest species yet examined from the West Indies, and unlike the females of the other species it has little trace of the elytral rugosities usually present along the sides. Other individuals may show more as there is often considerable variation.

Alethaxius acuñai, n. sp.
Fig. 9

About 3 mm in length, oblong, densely punctate, shining, deep reddish brown with a faint aeneous lustre more marked on the prothorax; hind femora with a prominent tooth; margin of prothorax entire; elytra in female with nodulation below the humeri and along the sides, in both sexes the apical half somewhat costate.

Head shining, without depressions, with scattered punctures more densely placed on lower front. Antennae brownish, extending well below the humeri, the five distal joints wider and with darker tips. Prothorax about a third wider than long, with rounded, entire sides, a tooth at basal and apical angles; surface densely and moderate coarsely punctate. Elytra in both sexes densely punctate in basal half, in apical half the punctures becoming striate and less dense with the interspaces becoming a little costate; in the female, the lateral costae more developed and irregular, in some specimens with nodules down the sides below the humeri. Body beneath shining reddish brown, the legs and abdomen a little paler, lightly pubescent; the hind femora with a distinct tooth, the two anterior pairs of femora with vestiges of toothing. Length 2.8–3.6 mm; width 1.4–1.7 mm.

Type male and 2 paratypes (female), U.S.N.M. no. 58361; 1 paratype in M.C.Z.

Type locality.—Moa, Oriente Province, Cuba, collected November 3–16, 1945, by J. Acuña.

Remarks.—This is the second species to be

described from Cuba and the second West Indian species with entire and not angulate or toothed sides to the prothorax. There is a suggestion of angularity in some of the specimens, and it is possible that it may be developed still further in some individuals. The toothing on the hind femora is distinct, but only faint on the other femora. Like most of the species of the genus, the female shows irregular nodulation on the sides of the elytra. Compared with *A. turquinensis*, *A. acuñai* is smaller and paler and has less distinctly toothed femora and a quite differently shaped aedeagus.

ENTOMOLOGY.—*The* Aedes (Mucidus) *mosquitoes of the Pacific (Diptera: Culicidae)*.[1]

KENNETH L. KNIGHT, Lt. Commander, H(S), U.S.N.R. (Communicated by R. E. BLACKWELDER.)

The subgenus *Mucidus* is distinguished by the following characters: Wing membrane surrounding the cross veins clouded; palpi of male longer than proboscis, segments IV–V declined, tip of III and all of IV with many very long ventrolateral hairs, V with hairs but these sparser and shorter; male mesosome simple, not divided into lateral plates; claspettes present, with distinct articulated appendages; *ppn* bristles numerous (10–30); lower mesepimeral bristles present; eighth segment of female abdomen completely retractile, cerci long and narrow; larval mouth parts modified for predacity, the mouth brushes forming matted tufts of serrate-tipped rods, the mandibular teeth very large and strong; and larval ventral brush extending the complete length of the anal segment. Members of the subgenus occur in the Tropics of the Ethiopian, Oriental, and Australasian Regions.

The subgenus has been divided by Edwards (1932) into two groups: Group A (*Mucidus*) and Group B (*Pardomyia*) (see keys for separation points). Group B does not occur in the Ethiopian Region. The subgenus contains the following species and subspecies: Group A: *alternans* (Westwood), *grahami* (Theobald), *kermorganti* (Laveran), *laniger* (Wiedemann), *mucidus* (Karsch), *nigerrimus* (Theobald), and *scatophagoides* (Theobald). In addition, a new species from the Philippines is described in this paper. Group B: *aurantius aurantius* (Theobald), *a. chrysogaster* (Taylor), *a. nigrescens* (Edwards), and *quadripunctis* (Ludlow).

In the species' synonymic tables that follow, all additional references containing important descriptive, biological, or distributional data are cited.

KEY TO ADULTS

1. Palpi of female over one-half as long as proboscis; scutum with twisted tufts of erect long white scales; about 20–30 *ppn* bristles, some along dorsal margin of *ppn;* general coloration white, yellow, and brown. . . . (Group A. *Mucidus*) 2
   Palpi of female barely one-fourth length of proboscis; scutal scales normal; about 10–16 *ppn* bristles, few or none along dorsal margin of *ppn;* general coloration golden, dark brown, and black. . . . . (Group B. *Pardomyia*) 9
2. Tibia with the distal white band subapical; Australasian 3
   Tibia with the distal white band apical; Ethiopian and Oriental 4
3. Leg scales decumbent and appressed; New Caledonia . . . . . *kermorganti* (Laveran)
   Leg scales long and erected; Australasian. . . . . *alternans* (Westwood)
4. Fore and mid tibiae with a well-developed median white band (fore tibia with apical white band not occupying more than 0.25 of length of segment) 5
   Fore and mid tibiae without a median white band (occasionally a few pale scales present however) 6
5. Tarsal segment I with distinct basal and median white bands; fore and mid tarsal segments II–III (and often IV–V) with basal white bands; Ethiopian and Oriental . . . . . *scatophagoides* (Theobald)
   Tarsal segment I with only a narrow basal

[1] This is the seventh paper of a series prepared in part on collections made in the Philippine Islands under the auspices of U. S. Naval Medical Research Unit No. 2. The work was done in space furnished by the Division of Insects, U. S. National Museum. Additional specimens were made available from the U. S. National Museum by Dr. Alan Stone, and from the Academy of Natural Science of Philadelphia by Dr. H. R. Roberts. N. D. Riley and H. Oldroyd made it possible to examine types in the British Museum.
Received April 23, 1947.

white band; tarsal segments II–V unbanded; Philippines.....*ferinus*, n. sp.

6. Second hind tarsal segment brown, sometimes a few scattered white scales along its length (hind tarsal segments III–V all white except narrowly at apex); Oriental .....*laniger* (Wiedemann)

Second hind tarsal segment with at least a distinct basal white band; Ethiopian....7

7. Second and third hind tarsal segments only rather narrowly white at base; costa largely yellow.....*mucidus* (Karsch)[2]

Third hind tarsal segment white except at tip; costa dark.....8

8. Second hind tarsal segment less than half white.....*nigerrimus* (Theobald)

Second hind tarsal segment all white except at tip.....*grahami* (Theobald)

9. Scutum entirely golden scaled (may be a few dark scales scattered about); Philippines.. .....*quadripunctis* (Ludlow)

Scutum with considerable areas of dark scaling.....10

10. Scutum with a moderately broad median transverse band of golden scales extending right across the scutum, reaching this but not passing it is a broad stripe of golden scales; Australia[3]..... .....*aurantius chrysogaster* (Taylor)

Scutum not marked as described above...11

11. Terminal abdominal tergites (V–VIII) broadly yellow; Australasian and Oriental .....*a. aurantius* (Theobald)

Terminal abdominal tergites with yellow scaling largely confined to mediodorsal area (this is not so true of the males, which are not readily separable from *a. aurantius*); Solomon Islands..*a. nigrescens* (Edwards)

KEY TO LARVAE[4]

1. Siphon hair tuft attached between the two distal pecten teeth (Fig. 5), which are more widely spaced, occasionally inserted just beyond apical pecten tooth; (siphon hair tuft inserted beyond middle).... (Group B. *Pardomyia*).....2

Siphon hair tuft inserted distinctly beyond last pecten tooth (Fig. 4).... (Group A. *Mucidus*).....3

2. Siphon hair tuft with about 6 branches; comb patch consisting of about 20–26 scales; pentad hair 2 single; Oriental and Australasian..*aurantius aurantius* (Theobald)

Siphon hair tuft with 11–15 prominently plumose hairs (Fig. 5); comb patch consisting of about 50–65 scales; pentad hair 2 double; Philippines..... .....*quadripunctis* (Ludlow)

Solomon Islands...*a. nigrescens* (Edwards)

3. Pecten teeth with 2–5 ventral denticles (head hair 5 extending forward well beyond the base of 3); Australasian..... .....*alternans* (Westwood)

Pecten teeth with 1–2 ventral denticles (Fig. 4).....4

4. Comb scales fewer than 50; Ethiopian and Oriental.....*scatophagoides* (Theobald)

Comb scales more than 50.....5

5. Siphon scarcely tapering; siphon hair tuft inserted just beyond middle; last 3 pecten teeth more widely spaced than the others and simple; African.*nigerrimus* (Theobald)

Siphon tapering at least on distal third; siphon hair tuft inserted before middle; the last pecten teeth not more widely spaced, nor simple (Fig. 4).....6

6. Pecten consisting of 25–27 teeth; African... .....*mucidus* (Karsch)

Pecten consisting of 12–16 teeth; Philippines .....*ferinus*, n. sp.

[2] This section of the key, which relates to the purely African species, has been taken from Edwards (1941, p. 110).

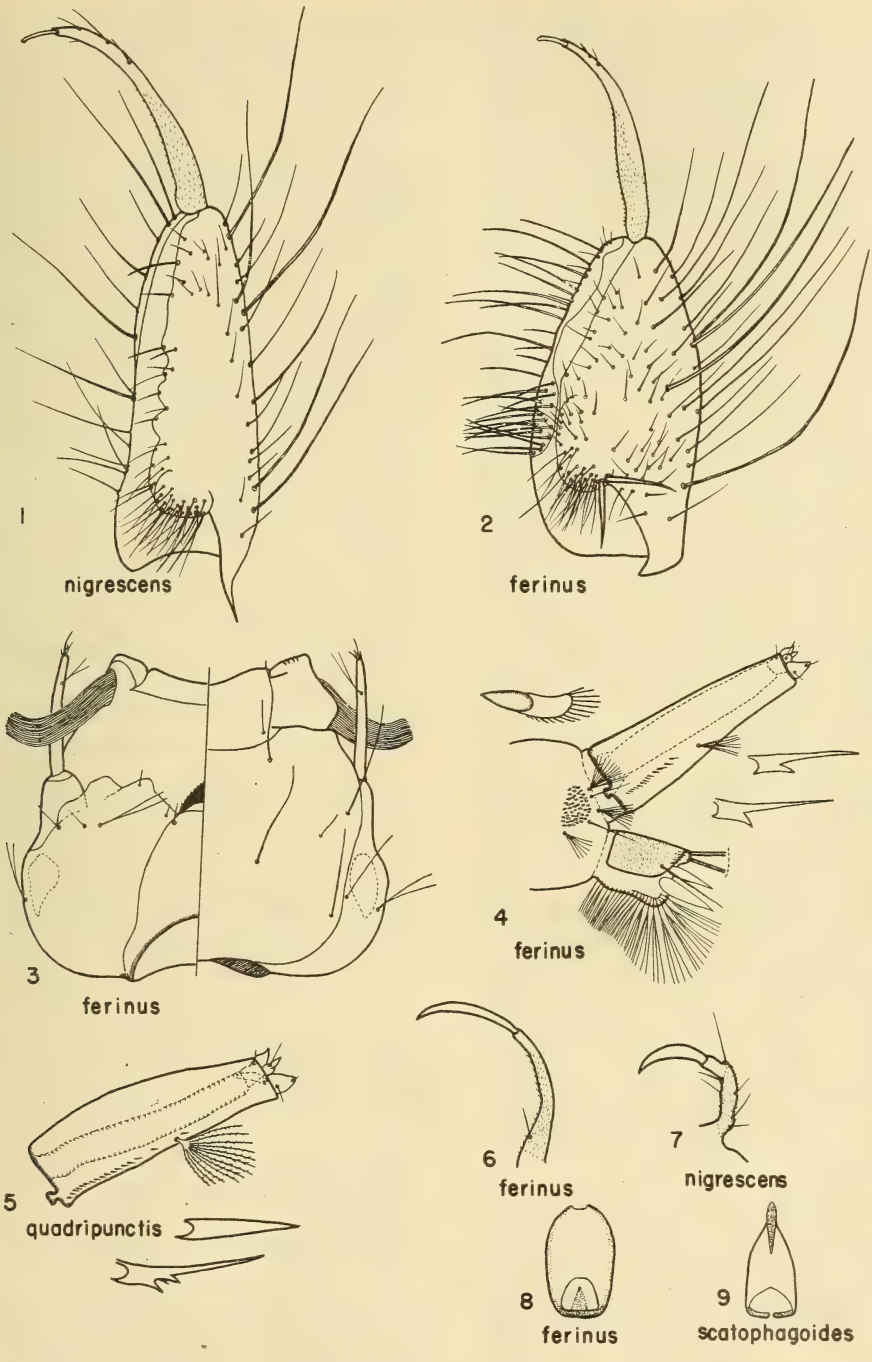
[3] No specimens were seen. The key character here is taken from the type description.

[4] The larvae of *grahami*, *kermorganti*, *laniger*, and *chrysogaster* are unknown. The larvae of *a. aurantius*, *scatophagoides*, *mucidus*, and *nigerrimus* have not been seen by me.

Aedes (Mucidus) ferinus, n. sp.
Figs. 2, 3, 4, 6, 8

ADULT. *Male.* Wing approximately 5.5 mm in length. *Head:* Proboscis largely yellow-scaled, the scales on the basal three-fifths somewhat outstanding and many of them with dark tips or particolored (particularly ventrally), an inconspicuous narrow white band just beyond middle, some white scales at apex; entire proboscis with numerous short hairs. Palpus longer than the proboscis by about the length of the last segment; clothed with yellow, white, and particolored brown scales, many of which are partially erect, segments II-V with basal white bands. Torus and first flagellar segment with broad white scales mesally. Vertex with narrow-curved white scales dorsally, these most numerous medially; elongate spatulate white scales scattered in this area; forked upright scales cream colored, scattered over posterior two-thirds of dorsum; broad white scales laterally, and along the eye margins part way to dorsal midline.

Thorax: Scutal integument grayish, marked with a lateral brown area before the scutal angle and one on the prescutellar area; clothed sparsely with narrow and narrow-curved white scales, several twisted tufts of erect long white scales present. Scutellum with many erect twisted elongate white scales on all lobes. *Apn* and *ppn* (about 24 anterior and posterior



FIGS. 1–8. *Aedes* mosquitoes of subgenus *Mucidus* (in each case the general geographical locality is given for the specimen from which the drawing was made): 1 (Guadalcanal) and 2 (Mindanao), Inner tergal aspect of basistyle of male genitalia; 3 (Mindanao), larval head, left half ventral, right half dorsal; 4 (Luzon), lateral aspects of larval terminal segments; 5 (Leyte), lateral aspects of larval siphon; 6 (Luzon) and 7 (Guadalcanal), lateral aspect of dissected claspette; 8 (Luzon) and 9 (Senegal, Africa), tergal aspect of mesosome.

dark hairs present) covered with broad white scales, some erect twisted scales also present. Following pleural areas each with a patch of mixed flat broad and erect twisted white scales: proepisternum, postspiracular (only a very few), subspiracular, paratergite, prealar (very few on knob, those below knob connecting with those on upper sternoplueron), upper sternopleural; ventroposterior sternopleural, medioanterior sternopleural (this sometimes joining the other two sternopleural scale patches); upper three-fifths (except extreme dorsum) of mesepimeral (dorsal mesepimeral hair tuft with about 7–9 hairs; 3–5 lower mesepimeral hairs present in scale patch). Pleural sclerites with pronounced integumental pale areas at the scale patches. Coxae and trochanters white scaled, some particolored brown scales on fore coxa. Femora, tibiae, and first two hind tarsal segments with many erect white and particolored brown scales. Femora clothed with particolored brown scales; each marked by narrow basal and apical white bands and by a narrow band at basal one-fourth and at apical three-fourths. Tibiae the same, each marked with a basal, median, and apical band (the apical band of the fore tibia is 0.20–0.25 as long as the whole tibia). Fore tarsi yellow (may be a few basal white scales on I); mid yellow, a narrow basal band on I; hind with narrow basal white bands on I (has a few erect white scales scattered along medially also) and II, III–V white with narrow yellow apices. Fore and mid tarsal claws unequal, the larger bidentate, the smaller unidentate; hind claws equal, unidentate. Wings clothed with small broad intermixed brown, yellow, and white scales; fringe with alternating dark and light areas; base of posterior fork cell slightly more basal than that of the anterior (this cell shorter than its stem). Halters white scaled.

Abdomen: Tergite I with white scales medially and laterally; II–VII with a baso-lateral patch of erect twisted white scales; II–IV white scaled medially, brown and yellow scaled laterally; V–VII white scaled, with an apicolateral patch of brownish-yellow scales; sidepieces white scaled basally, dark apically. Sternites II–VI brownish yellow with white basal bands, VII–VIII all white. *Genitalia* (Figs. 2, 6, 8): Inner tergal surface of basistyle with distinctive setal pattern; large basal lobe present bearing two broad spines and numerous hairs. Claspette blade rather widened medially. Mesosome evenly rounded apically and without beak or flange. Ninth tergite lobes each with 3–8 broadened setae. Eighth tergite and sternite with several large broad swordlike setae apically.

Female: Wing approximately 6.0–7.0 mm in length. Proboscis with a broad median white scaled area. Palpus approximately two-thirds to three-fourths as long as the proboscis, clothed with white and particolored brown scales intermixed. Vertex with forked upright scales brown. Some of the scutal scales have a very pale yellowish tint. Only middle one-third of mesepimeron scaled, the dorsal hair tuft consisting of about 20–24 hairs. First hind tarsal segment approximately 0.8 as long as the tibia. Tarsal claws equal, each unidentate.

LARVA. *Head* (Fig. 3): Antenna with a few very small spicules; antennal hair tuft inserted at apical one-fourth, with 2 branches. Hairs 3 (slender), 4, 5, 6, 7, and 8 single; 9 with 1 or 2 branches; 12 single; 13 double; 14 and 15 with 1–3; 17, 18, and 20 single. Hair 5 not extending beyond the base of 6. Mentum with 6 or 7 teeth on each side. Mouth brushes forming matted tufts of serrate-tipped rods.

Thorax: Prothoracic hair 0 with 5 or 6 branches; 1, 2, and 3 single (3 once double). Mesothoracic hair 9 with 3–6 branches; 10 and 12 single (11 not seen). Metathoracic hair 9, 10, and 12 single (11 not seen).

Abdomen (Fig. 4): Dorsolateral hair of segments I–II single. Lateral hair of I with 6–8 branches; of II with 8–11; of III–VI single. Pentad hair 1 with 17–20 branches; 2 and 4 single; 3 with 6–8; 5 with 5–7; hairs 1, 3, and 5 stellate in type. Comb consisting of a patch of about 50–65 broad apically fringed scales. Siphon pale; index 2.7–4.4; acus present; hair tuft inserted just before middle and distinctly distad to the last pecten tooth, with 5–7 short branches; 12–16 pecten teeth, each with a sharp subbasal denticle. Anal plate incomplete ventrally, with transverse striations, some posterior spines present dorsally; *lh* single; *isc* single. Ventral brush, which extends the whole length of anal segment, consists of 30–32 tufts, those along the posterior half arising from a barred area, each tuft with 7–9 branches. Anal gills lanceolate, with the ventral pair slightly longer than the dorsal pair and about 0.7 as long as the anal plate.

Holotype.—Male, with associated larval and pupal skins (U.S.N.M. no. 58363), San

Ramon (Penal Farm), City of Zamboanga Province, Mindanao, Philippines, October 2, 1945 (J. L. Laffoon and K. L. Knight), reared from a grassy ground pool.

Paratypes.—One male with associated larval and pupal skins, same data as for holotype; 15 males, 3 females, Zamboanga, Mindanao, September 12, 1945 (J. L. Laffoon, D. R. Johnson, K. L. Knight), from a light trap; 1 male, 1 female, 2 sets of associated larval and pupal skins, Olongapo (Subic Bay), Zambales Province, Luzon, July 21, 1945 (L. E. Rozeboom, E. S. Zolik), reared from a grassy area inundated by rains; 2 females, Dulag, Leyte, November 25, 1944 (H. R. Roberts), reared from a marshy pool. Paratypes deposited in U. S. National Museum, British Museum, and Academy of Natural Sciences of Philadelphia.

Remarks.—This species is most closely related to *laniger* Wiedemann but differs in having only about the apical 0.20–0.25 of the fore tibia white-scaled, in possessing sharp median white bands on the fore and mid tibia, and in having a distinct basal band on the second hind tarsal segment.

Aedes (Mucidus) scatophagoides (Theobald)

Fig. 9

1901. *Mucidus scataphagoides* Theobald, Mon. Cul. 1: 277 (female). TYPE-LOC.: Burma. Myingyan (Watson). India. Morabad, N.-W. P. (Close). TYPE: 2 females (cotypes) in Brit. Mus. Theobald, 1910: 126. Barraud, 1929: 1053. Christophers, 1906: 13.

1908. *Mucidus sudanensis* Theobald, 3d Rep. Wellc. Lab., p. 252 (female). TYPE-LOC.: Africa. Upper White Nile (King). TYPE: Female in Brit. Mus. Theobald, 1910: 129.

1911. *M. scatophagoides*, Theobald. Edwards, p. 246. Name emended, but without comment. Synonym of *sudanensis* Theobald. Edwards, 1911: 246; 1922a: 450.

1932. *A.* (*M.*) *scatophagoides* Theobald. Edwards, p. 135. Barraud, 1934: 138. Edwards, 1941: 110. Hopkins, 1936: 99.

ADULT. This species differs distinctly from *ferinus* in tarsal markings and male genitalia. Fore and mid tarsi with distinct basal and median white bands on I, basal white bands on II and III, segments IV and V usually all yellow but may also bear basal bands; hind tarsi with basal and median white bands on I, basal white bands on II–V, the band on II occupying about one-third of the segment, those on III–V about one-half. Abdominal tergites II–III tend to have the median white scales confined to the base with the remainder of the median area yellow-scaled. The mesosome of the male genitalia is distinct in possessing a remarkable apical flange or beaklike process (Fig. 9). Also apically on the mesal margin of the inner tergal surface of the basistyle there are a few hairs which are longer than the surrounding ones.

In the material examined, African specimens were distinct from the Oriental ones in having the proboscis all yellow-scaled (many brown scales on proximal half). The female of the Oriental material has the median portion of the proboscis with a variable amount of white scaling and the male has a small indefinite median band of white scales. It would seem possible on the basis of this color distinction to regard the African material as sufficiently distinct to constitute a geographical subspecies (in which case Theobald's name *sudanensis* would be available), but considerable material would necessarily have to be examined first. A difference also possibly occurs in the distribution of setae on the inner tergal surface of the basistyle.

LARVA. Not seen. Although closely similar to that of *ferinus*, its possession of only 30–40 comb scales and 20–30 pecten teeth (each with 1, rarely 2, ventral denticles) may constitute a significant difference. Also, Hopkins (1936, Fig. 45) figures head hair 5 extending cephalad beyond the base of hair 3, and hair 6 extending one-half of its length beyond the anterior margin of the head.

Habitat.—The larvae, which are predatory on other mosquito larvae, are found in all types of temporary open natural pools. Hopkins (1936) believes that the eggs may be laid on a dry surface and that they may need to undergo a period of drying before a flooding will hatch them.

The type females were captured while biting patients in a hospital and one of them deposited separated eggs when placed in a slanted test tube over water.

Distribution.—SPECIMENS EXAMINED: U.S. N.M. (3 males, 3 females): *India* (S. R. Christophers). Amritsar (S. R. C.); Calcutta, Bengal (D. E. Hardy, G. F. Johnstone). Also 1 male and 3 females from Africa. British Museum (1 male, 1 female): *India*. Behar: Pusa (F. M. Hewlett). N. Canara: Karwar (H. Cogill).

ADDITIONAL RECORDS FROM THE LITERATURE: Throughout tropical Africa. Widely distributed in the Oriental Region from Rajputana to Burma, and through Central Provinces and Madras to Ceylon (Barraud, 1934). *China.* Kwangtung: Hongkong (Feng, 1938).

Aedes (Mucidus) laniger (Wiedemann)

1821. *Culex laniger* Wiedemann, Dipt. Exot., p. 9 (female). TYPE-LOC.: Java. TYPE: Female in Copenhagen Mus.
1901. *Mucidus laniger.* Wiedemann. Theobald, p. 269.
1908. *Mucidus mucidus.*—Theobald. Leicester, p. 69.
1913. *Mucidus laniger* (Wied.). Edwards, p. 224. Synonymy of *mucidus* Leicester, 1908. Edwards, 1922a: 451. Barraud, 1929: 1053.
1932. *A.* (*M.*) *laniger* Wiedemann. Edwards, p. 134. Barraud, 1934: 147. Bohart, 1945: 55.

ADULT. No mention is made in the literature of whether Wiedemann's type has ever been reexamined; and since no one has redescribed material from the type locality, the exact determination of *laniger* remains somewhat in doubt. This uncertainty is largely due to the incompleteness of Wiedemann's description and to the discrepancies existing between it and the material assigned to this species by various authors.

I have examined a female specimen from Deli, Sumatra, in the collection of the British Museum, which I am at present considering to be *laniger*, largely because of the nearness of its collection locality to that of the type. This specimen resembled *ferinus* except as follows: proboscis brownish yellow with a few white scales about the middle and at the extreme apex; apices of tibiae appearing more broadly banded; fore and mid tibiae with only basal and apical white bands, hind tibia also with a median band; segment I of hind tarsi with a basal white area and with some white scales scattered along the rest of the segment, II brown with a few white scales scattered over length, III and IV all white except for a narrow apical brown band, V largely white.

The only descriptive notes found in the literature on this species (in addition to the original description) are by Macquart (1838, p. 176) from a female from Coromandel (probably Madras, India); Leicester (1908, p. 69) from Kuala Lumpur, Malaya; Edwards (1913, p. 224; 1922a, p. 451); and Barraud (1934, p. 147) from Ceylon and possibly Assam material. Edwards's notes check with the specimen described above. He states that the first hind tarsal segment is nearly as long as the hind tibia, which is a character I did not check on the Sumatran specimen. Barraud's description is similar.

Leicester's specimens were examined by me in the British Museum and did not appear to differ from the Sumatran specimen. However, in his description he states that the hind tarsi have a narrow basal white band on I, with the rest all white scaled. This is probably an error due to not seeing the separation point between segments I and II. He describes the smaller fore tarsal claw and both hind claws of the male as being simple. Unfortunately I did not check this statement, but if true it constitutes a rather striking difference between *laniger* and *ferinus.*

Wiedemann has several points in his description that do not check either with the Sumatran specimen or with the descriptions mentioned above. According to Theobald's (1901, p. 269) translation, Wiedemann described the proboscis as being yellow with a white band at apex, and the hind tarsi as having white apices. These are the main discrepancies existing in his description and could both easily be errors in observation of color versus structure.

Macquart's notes on a specimen from Coromandel mention that all the tarsi have white basal bands on each segment. This seems very much as if he had a specimen of *scatophagoides.*

I have examined a female from Ceylon in the British Museum that checked with the Sumatran specimen except for the minor points of having a few median white scales on the fore and mid tibiae and having the fore and mid tarsi all dark.

In the U. S. National Museum collection there are two Philippine females of this species that check well with the Sumatran specimen. In these specimens the apical 0.31–0.33 of the fore tibia is white scaled. The specimens differ from *laniger* as described by Edwards and Barraud, however, in having the first hind tarsal segment only 0.81–0.89 as long as the hind tibia. There is also an unassociated male genitalic slide in the U.S.N.M. that is labeled "*Mucidus laniger* Wied." It is very similar to *ferinus* except that the large spines on the basal

lobe of the basistyle are noticeably slenderer.

LARVA. Undescribed.

Distribution.—SPECIMENS EXAMINED: U. S. N.M. (2 females, 1 male genitalic slide): *Philippines.* Mindanao: Ludlow Barracks, Parang; Pettit Barracks, Zamboanga (F. Visaya). British Museum (3 females, 1 male): *Malaya.* Kuala Lumpur (G. F. Leicester). *Ceylon.* Trincomali (C. F. S. Baker). *Sumatra.* Deli (A. F. Stanton).

ADDITIONAL RECORDS FROM THE LITERATURE: *Assam* (?) (Barraud, 1934). *Sumatra.* Atchin: Tjane. Djambi: Moeara Tebo. Lampong districts: Semangka Plain (Brug and Edwards, 1931). *Philippines.* Luzon: Manila (Banks, 1906). Mindoro: Calapan (Edwards, 1929).

Aedes (Mucidus) alternans (Westwood)

1835. *Culex alternans* Westwood, Ann. Soc. Ent. France **4**: 681 (female). TYPE-LOC. Nova Hollandia (Australia). TYPE: Female originally in Hope Coll., Oxford; now in Brit. Mus. Westwood, 1881: 384. Skuse, 1889: 1726.

1856. *Culex commovens* Walker, Insecta Saundersiana 1: 432 (females). TYPE-LOC.: New Holland (Australia) (Saunders). TYPE: female (holotype) in Brit. Mus. (identified as type by E. A. Waterhouse).

1889. *Culex hispidosus* Skuse, Proc. Linn. Soc. New South Wales **3** (n.s.): 1726 (males, females). TYPE-LOC.: Hexham Swamp, near Newcastle and Richmond, New South Wales (Skuse); Mount Kembla, Illawarra, New South Wales (Hamilton); Breakfast Creek, Brisbane, Queensland (Tryon). TYPE: Location unknown to me.

1901. *Mucidus alternans.* Westwood. Theobald, p. 269. Synonymy of *commovens* and *hispidosus.* Hamlyn-Harris, 1933: 230. Cooling, 1924: 17. Edwards, 1924: 367; 1922a: 450. Theobald, 1903: 134; 1907: 162; 1910: 125. Felt, 1905: 473.

1932. *A.* (*M.*) *alternans* Westwood. Edwards, p. 134. Lee, 1944: 48, 50.

ADULT. Resembling *ferinus* but differing chiefly as follows: *Male.* Proboscis without a median white scaled area. Scutum white scaled, marked with distinct areas of yellow scaling. Postspiracular area with many broad white scales; all of mesepimeron scaled except ventral margin; pleuron rather uniformly brown colored. Femora with apical white scaling much reduced, sometimes even lacking on fore femur; fore femur with the subbasal white band usually absent; hind femur sometimes with whole basal one-half white. Tibiae each with basal, median, and subapical white bands. Fore and mid tarsi with basal and medium white bands on I (in Australian material, these two bands tend to coalesce), II and III with basal three-fifths white; hind tarsi with a basal and median band on I, II and III with about basal one-half white, IV and V with about basal three-fourths white. Tergites II–III largely yellow dorsally, a few median white scales; IV–VII with broad white basal areas, the white extending posteriorly on the midline. Genitalia essentially as in *ferinus* except that there are 1–2 stouter, more elongate setae apically on the inner margin of the inner tergal surface of the basistyle (figured by Felt, 1905, pl. 7).

Female. Vertex with the scales along the eye margins and on the midline white, narrow yellow scales subdorsally, broad yellow scales laterally, some broad white scales at extreme lateral margins. Scutum brownish-yellow scaled, several tufts of erect twisted white scales. Tergites largely yellow dorsally, basal white bands on V–VII, a basomedian white spot extending posteriorly on midline of IV–VII.

LARVA (1 larva, from New Caledonia). Closely similar to that of *ferinus*, but possibly differing as follows: head hairs 5 and 6 noticeably longer, 5 extending cephalad beyond the base of 3 and 6 extending about one-third of its length beyond the anterior margin of the head. (Meso- and metathoracic pleural tufts missing.) Pecten teeth 20–21 in number, most of them with 2–4 ventral denticles.

Habitat.—The predatory larva is commonly found in high-tide marshy pools, but during the seasons of low tides is often taken in inland fresh-water ground pools.

The adult is a vicious biter, even entering homes to do so, and bites mainly at sundown. It commonly migrates a considerable distance inland from the coast. The eggs are deposited singly on the water.

Remarks.—The types of *alternans* and of *commovens* have been examined by me. That of *alternans* is in such poor condition as to be almost completely unrecognizable.

The adult of this species is well distinct from either *scatophagoides, laniger,* or *ferinus* on the basis of the subapical white tibial band. The larva is apparently distinct in having pecten teeth with 2–4 denticles each.

Distribution.—SPECIMENS EXAMINED: U.S.

N.M. (16 males, 23 females, 1 larva): *New Caledonia.* (A. R. Gaufin); Ducas Penin. (K. L. Knight); Noumea (Dunlop): Baie Chambeyron, La Foa (Platsch and Remington). *Australia.* Queensland: Normantown and Townsville (G. F. Hill); Rockhampton and Townsville (F. H. Taylor); Burpengary (T. L. Bancroft); Eidsvold (C. F. Baker); Brisbane (Hamlyn-Harris); Cairns.

ADDITIONAL RECORDS FROM THE LITERATURE: *Australia.* Victoria. New South Wales. Northern Territory. *New Guinea.* Papua (Edwards, 1924).

Aedes (Mucidus) kermorganti (Laveran)

1901. *Culex kermorganti* Laveran, C. R. Soc. Biol. **53**: 568 (2 females). TYPE-LOC.: New Caledonia. Noumea. TYPE: Female (holotype), dissected and mounted on 2 slides, Pasteur Institute, Paris.
1922. *Mucidus kermorganti* (Laveran). Edwards, 1922a, p. 99. Edwards, 1922b: 450; 1924: 367.
1932. *A.* (*M.*) *kermorganti* Laveran. Edwards, p. 134.

ADULT. Apparently indistinguishable from *alternans* except that the scales of the abdomen and legs are very small and all closely appressed.

This species is still known only from the type series. According to Edwards (1922a), there were two females (apparently the type series) of this species in the Paris Museum. Of these, one specimen, from Calama, 1869 (Delacour), was presented to the British Museum where I examined it in 1946. The other specimen, judged from Edwards's (1922a) account, should still be in the Paris Museum.

However, J. A. Reid, who kindly searched for Laveran's types for me in the collections of the Paris Museum in October 1946, was unable to find the *kermorganti* type there. But in the collections of the Pasteur Institute, Paris, along with other Laveran types, he did find a dissected, slide-mounted female of this species. This I am considering to be the type for the species.

Aedes (Mucidus) quadripunctis (Ludlow)
Fig. 5

1910. *Pardomyia quadripunctis* Ludlow, in Theobald, Mon. Cul. **5**: 608 (female). TYPE-LOC.: Philippines. Parang. Mindanao. TYPE: female (holotype) in U.S.N.M. Edwards, 1922b: 451.
1932. *A.* (*M.*) *aurantius* var. *quadripunctis* Ludlow. Edward, p. 135.
1945. *Aedes* (*Mucidus*) *quadripunctis* (Ludlow). Bohart, p. 55.

ADULT. *Male.* Wing approximately 4.2–4.7 mm in length. *Head:* Proboscis yellow-scaled, some black scales basally on ventral and lateral aspects, may be a few apical dark scales also. Palpus equal to proboscis in length, or somewhat longer; yellow-scaled with sparse black scales at the apices of each segment, V with the apical one-half dark. Torus orange, bare. Vertex with narrow golden scales dorsally, thickest along eye margins; brownish-yellow forked upright scales over whole dorsum; broadened yellow scales laterally.

Thorax: Scutal integument brownish gray, with areas of dark brown; sparsely clothed with narrow yellow scales (some scattered brown scales may also be present). Scutellum with narrow yellow scales on each lobe. *Apn, ppn* (about 10–13 posterior bristles) and proepisternum sparsely covered with narrow and narrow-curved yellow scales. A small patch of broadened elongate yellow scales on each of the following areas: paratergite, prealar (below the knob), upper sternopleural, ventroposterior sternopleural and middle mesepimeral. Coxae yellow-scaled, fore may also have a median patch of black scales. Trochanters with mixed dark and yellow scaling. Femora and fore and mid tibiae yellow, with a variable amount of spotted black scaling, these dark markings reduced posteriorly; hind tibia black, marked with a small basal yellow band and some yellow mottling. Fore and mid tarsi yellow, the apical half of II and all of III and IV may show a dusky sheen; hind tarsus black, I–III with narrow basal yellow bands (that on III may be absent), V completely creamy-white scaled. Fore and mid tarsal claws unequal, each with a single tooth; hind claws equal, simple. Wings with costa and vein 1 covered with very small yellow and black scales, remainder of veins with such small scales as to appear virtually unscaled; both forkcells considerably shorter than their stems, the second fork cell beginning more basally than the first. Halter pale, knob dark and pale scaled.

Abdomen: Tergites golden-scaled, usually some scattered dark scales on one or more of the segments. Sternites golden scaled, some dark scales on II–III. *Genitalia:* Apparently not dis-

tinct from that of *a. nigrescens* (see Figs. 1 and 7).

Female. Wing approximately 5.0–5.7 mm. in length. Palpus approximately one-fourth the length of the proboscis; golden, with apices dark. Torus mesally with a patch of golden scales. Tarsal claws equal, each unidentate. In general, the legs of the female have more extensive dark scaling than they do in the males. The fore and mid tarsi may be largely dark with basal pale bands on I and II. The abdominal tergites may also have more scattered black scales than described for the male.

LARVA (description based on 5 adult-associated skins from Leyte). Closely similar to that of *ferinus* but differing most noticeably as follows: Antennal hair tuft with 3–5 branches. Head hair 3 located on the line of the suture, broad basally and tapered acutely (not a normal slender hair as in *ferinus*); hair 5 extending beyond the base of hair 6 nearly to the anterior margin of head; hair 20 double. Mesothoracic hair 9 with 6 or 7 branches. Metathoracic hair 9 with 8 or 9 branches. Lateral hair of abdominal segments III–IV double; of V–VI single. Pentad hair 1 with 11–15 branches, 2 double, 5 with 9–14. Siphon hair tuft (Fig. 5) inserted just beyond the middle of the siphon and between the last two pecten teeth, the base of the tuft strongly fan-shaped, with 11–15 prominently plumose branches. Pecten teeth 17–22 in number, sharply pointed and with 2–4 ventral denticles; the last two teeth more widely separated than the others, simple or with only 1 or 2 very small denticles. Anal plate with posterior margin smooth. Ventral brush consisting of 22–26 tufts, the basal 6 or 7 not arising from the barred area, each tuft with 7–11 branches.

Habitat.—The larvae, which are obviously predacious, were collected from rain-filled temporary puddles.

Remarks.—Closely similar to *a. aurantius* (see under that species for differences). The type has been examined, and all the scutellar scales were found to be yellow instead of partly brown as described by Ludlow.

The larva has not previously been described.

Distribution.—SPECIMENS EXAMINED: Acad. Nat. Sci. Philadelphia (4 males, 5 females, 5 sets of adult-associated larval and pupal skins): *Philippines.* Leyte: Tacloban and Dulag (H. R. Roberts). U.S.N.M. (1 female): *Philippines* (R. C. McGregor).

Aedes (Mucidus) aurantius aurantius (Theobald)

1907. *Pardomyia aurantia* Theobald, Mon. Cul. 4: 280 (female). TYPE-LOC.: Borneo. Kuching, Sarawak (Barker). TYPE: Female (holotype) in Brit. Mus.
1908. *Ekrinomyia aureostriata* Leicester, Cul. Malaya, p. 71 (males, females). TYPE-LOC.: Malaya. Klang, Kuala Lumpur (Leicester). TYPE: 3 females, 3 males (cotypes), in Brit. Mus.; 1 female (cotype) in U.S.N.M.
1913. *Pardomyia aurantia,* Theo. Edwards, p. 224. Synonymy of *aureostriata* Leicester. Edwards, 1922b: 451. Paine and Edwards, 1929: 305.
1931. *M.* (*Pardomyia*) *aurantius* Theo. Brug and Edwards, p. 257.
1932. *A.* (*M.*) *aurantius* Theobald. Edwards, p. 135.
1944. *Aedes* (*Mucidus*) *aurantius aurantius* (Theobald). Knight, Bohart, and Bohart, p. 33.

ADULT (described from Theobald's and Leicester's type material). Closely similar to *quadripunctis* but chiefly distinct in having the scutum dark scaled except for a prominent anterior transverse area of narrow yellow scales (also a few yellow scales around the prescutellar space and over the wing base).

Also: Proboscis may possess considerable black scaling. Forked upright vertex scales vary from golden to brownish in color. A few dark hairlike scales usually present on the subspiracular area along the dorsal-anterior margin of the sternopleuron. Wing fork cells nearly as long as their stems. In the female, tergites I–III are largely dark scaled; I with a narrow yellow band laterally, II–III with a divided median yellow patch, remainder of the tergites yellow except for occasional scattered dark scales. The tergites of the male marked approximately the same, except usually there are somewhat fewer dark scales. Male genitalia similar to that of *a. nigrescens* (see Figs. 1 and 7).

Leicester (1908) described the hind female claws as being simple, but actually they each have a very small tooth.

LARVA. Not seen. Described and figured however, by Edwards and Givens (1928, Singapore specimens) and by Lee (1944, specimens from Milne Bay, New Guinea). Dorsal characters of the head similar to those of *guadripunctis* except that Lee figures head hair 5 as not extending cephalad beyond the base of hair 6. Thoracic hairs not specifically described.

Dorsolateral hair of abdominal segment I single; lateral hair of I with 6 branches, of II with 10, of III–VII double. Comb patch of about 20–26 bluntly rounded and apically fringed teeth. Pentad hair (as fig. by Lee, 1944) 1 and 5 with 8 branches, 2 single. Siphon index about 2; acus well-developed; pecten composed of about 20 rather close-set teeth, each with 2–5 denticles, the line of teeth extending to just beyond the middle of siphon, the two distal teeth more widely separated than the others; siphon hair tuft with about 6 branches, inserted between the two distal pecten teeth. Anal segment as in *quadripunctis*.

PUPA. Partially figured and described by Edwards and Givens (1928).

Habitat.—The predacious larva has been reported from pig wallows, small clear marshy pools, a pot-hole in a mangrove swamp, and grass-grown pools in swamps.

Remarks.—All the type specimens of *a. aurantius* and *aureostriata* have been examined. This species is distinct in the adult from *quadripunctis* on the color of the scutal and abdominal tergal scales, and in the larva (possibly) on the length of head hair 5, on the number of comb scales, and on the number of branches of the siphon hair tuft and of pentad hair 2.

Distribution.—SPECIMENS EXAMINED: U.S. N.M. (8 males, 3 females): *New Guinea.* Papua: Gilli Gilli. Dutch New Guinea: Toem (long. 139°, lat. 1° 59′) (E. S. Ross).

ADDITIONAL RECORDS FROM THE LITERATURE: *Sumatra.* Lampong districts: Moeara Tebo. Riouw Archipel: Doerian (Brug and Edwards, 1931). *New Guinea.* Papua: Milne Bay (Lee, 1944).

Aedes (Mucidus) aurantius nigrescens
(Edwards)
Figs. 1, 7

1929. *Pardomyia aurantia* var. *nigrescens* Edwards, in Paine and Edwards, Bull. Ent. Res. **20**: 314 (female, larva). TYPE-LOC.: Solomon Islands. Lady Lever Plantation, Kulambangra (Paine). TYPE: female (holotype) in Brit. Mus.
1932. *A.(M.) aurantius* var. *nigrescens* Paine and Edwards. Edwards, p. 135.
1944. *Aedes (Mucidus) aurantius nigrescens* Edwards. Knight, Bohart, and Bohart, p. 50.

ADULT. Very similar to *a. aurantius* but differing chiefly in the color of the abdominal tergite scaling. In the female, tergites II–IV black marked with a narrow basal yellow line and a median pair of yellow spots, and sometimes with a few scattered yellow scales; V–VII black, each broadly marked by a median patch of yellow scales that reaches the posterior margin of the segment. The male tergites however, are colored practically as in *a. aurantius*, except that there are rather more scattered black scales laterally on IV–VII. Male genitalia (Figs. 1 and 7) similar to that of *guadripunctis* and *a. aurantius*.

LARVA. (2 larval skins from Solomon Islands). Apparently not separable from that of *quadripunctis*. In the type description, Edwards states that the larva differs from that of *a. aurantius* only in having the antenna slightly longer and the siphon distinctly longer (index about 2.7). However, the specimens in the U. S. National Museum differ from *a. aurantius* on the same characters that *quadripunctis* differs from it.

Habitat.—The predacious larva occurs in all types of rain-filled temporary puddles and pools, either in the open or in swamps or woodlands.

Remarks.—I have examined the type. As Edwards indicates, *a. nigrescens* appears to be only a geographical subspecies based essentially on female color characters. The larva is not distinct from that of *quadripunctis*.

Distribution.—SPECIMENS EXAMINED. U.S.-N.M. (5 males, 15 females, 4 sets of adult-associated larval and pupal skins, 2 larvae, 1 larval skin, 2 pupal skins): *Solomon Islands.* Guadalcanal: Lunga district (J. N. Belkin, A. B. Gurney, L. E. Rozeboom, J. L. Laffoon). New Georgia group: Banika Island (W. G. Downs). Bougainville: Torokina area (A. B. Gurney).

Aedes (Mucidus) aurantius chrysogaster
(Taylor)

1927. *Mucidus chrysogaster* Taylor, Bull. Ent. Res. **18**: 67 (female). TYPE-LOC.: Australia. Berner Creek, near Innisfail, Queensland (Taylor). TYPE: 2 females (holotype and paratype), in Australian Inst. Trop. Med., Townsville, Queensland.
1944. *Aedes (Mucidus) aurantius chrysogaster* Taylor. Knight, Bohart, and Bohart, p. 50.

Since the type description, there have been no additional published notes on this species;

nor have I seen the types. However, from a careful consideration of the type description, it appears to have no significant differences from *a. nigrescens* except in scutal markings. Taylor describes the scutum as follows: "Scutum chocolate-coloured, covered with mixed golden and chocolate-brown, narrow-curved scales; there is a moderately broad median transverse band of golden scales reaching right across the scutum, reaching this but not passing it is a broad (about a quarter the width of the scutum) stripe of golden scales, the golden scales are very pronounced on the anterior margin of the scutum."

The larvae were found in a shallow rock pool containing a large quantity of decaying vegetable matter.

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ZOOLOGY.—*Observations on the occurrence of certain barnacles and isopods at Beaufort, N. C.*[1] A. S. PEARSE, Duke University.

During the summer of 1946 collections were made of certain crustacean parasites that occurred on marine mollusks, crabs, shrimps, king crabs, and fishes at Beaufort, N. C. The results for copepods have already been published (1947). The present report deals with barnacles and isopods. Thanks are due to L. B. Hayes, David Busby, and Glen E. Mathisen who helped with the routine examinations. A new isopod is described. Specimens of this and other crustaceans have been deposited in the United States National Museum.

Order CIRRIPEDIA
Division LEPADOMORPHA
Octolasmis mulleri (Coker)

Coker (1902) wrote an excellent paper on the occurrence and development of this barnacle from studies he made at Beaufort. He examined

[1] Received March 31, 1947.

180 blue crabs (*Callinectes sapidus* Rathbun) and found 128 (71 percent) infested with these parasitic barnacles. The females more often carried barnacles in their gill chambers (89 percent) than males (56 percent). The number in crabs ranged from "one to as many as can be crowded into the branchial chambers —500 to 1,000, or perhaps more." Coker also at times found the barnacles in the branchial chambers of stone crabs (*Menippe mercenaria* Stimson) and spider crabs (*Labinia caniliculata* Say).

During the summer of 1946 (June 8–28) the writer examined 93 *Callinectes sapidus* and 22 (23.7 percent) contained from 1 to 84 barnacles. These numbers are below those reported by Coker, but he says that infestation was heavier in the latter part of the summer. The writer found a total of 554 barnacles, an average of almost six per crab.

Division Balanomorpha

Chelonibia patula (Ranzani)

Ninety-three blue crabs (*Callinectes sapidus* Rathbun) examined during June 1946 bore 1,592 of these barnacles on the carapace, legs, and abdomen; an average of 17 per individual. Those from deeper water had more than those from shallow shores; 7 taken in a trawl at a depth of 40 feet bore 485; one individual, 120. Of the 93 hosts examined, 57 bore Chelonibias (61 percent).

Four king crabs (*Limulus polyphemus* Linnaeus), examined on June 27, bore 198 barnacles; some of these were of this species, some of *Balanus amphitrite niveus* Darwin, and some too small to be placed specifically.

Order Isopoda

Tribe Cymothoida

Nerocila acuminata Schioedte and Meinert

On June 11 two fishes (banded croaker, *Larimus fasciatus* Holbrook; weakfish, *Cynoscion regalis* Bloch and Schneider), were found floating in the channel in front of the Duke University Marine Laboratory. Both of these had a female *Nerocila* in the mouth. On June 24 five harvestfishes, *Peprilus alepidotus* (Linnaeus), contained three more, and on June 26 three of the same fishes bore another one. On June 28 ten sea-robins, *Prionotus carolinus* (Linnaeus), had one in the mouth of one individual. On July 31 five spadefish, *Chaetodipterus faber* (Broussonet), furnished another in a branchial chamber. On August 21 a pinfish, *Lagodon rhomboides* (Linnaeus), had one in its mouth. All the hosts mentioned are spiny-rayed fishes (Acanthopteri), but Richardson (1905) reports this isopod from the sawfish, *Pristis pectinatus* Latham.

Tribe Bopyroidea

Probopyrus alphei Richardson

From the branchial chamber of a snapping shrimp, *Crangon heterochaelis* (Say), a female and her attached dwarf male were taken on July 29.

Probopyrus pandalicola (Packard)

From the branchial chambers of about 500 *Palaemonetes carolinus* Stimpson, taken at Mortons Mill Pond on July 2, 52 females were taken and 50 of these bore dwarf males.

Leidya distorta (Leidy)

Between May 28 and July 10, 435 fiddler crabs (*Uca pugilator* (Bosc)) were examined. In the branchial cavities of some of these 7 female and 5 male Leidyas were found. During August Dr. Martin Burkenroad brought in four fiddlers that he picked up after dark, as he observed that they were sluggish and appeared to be "sick." Three of these also contained Leidyas.

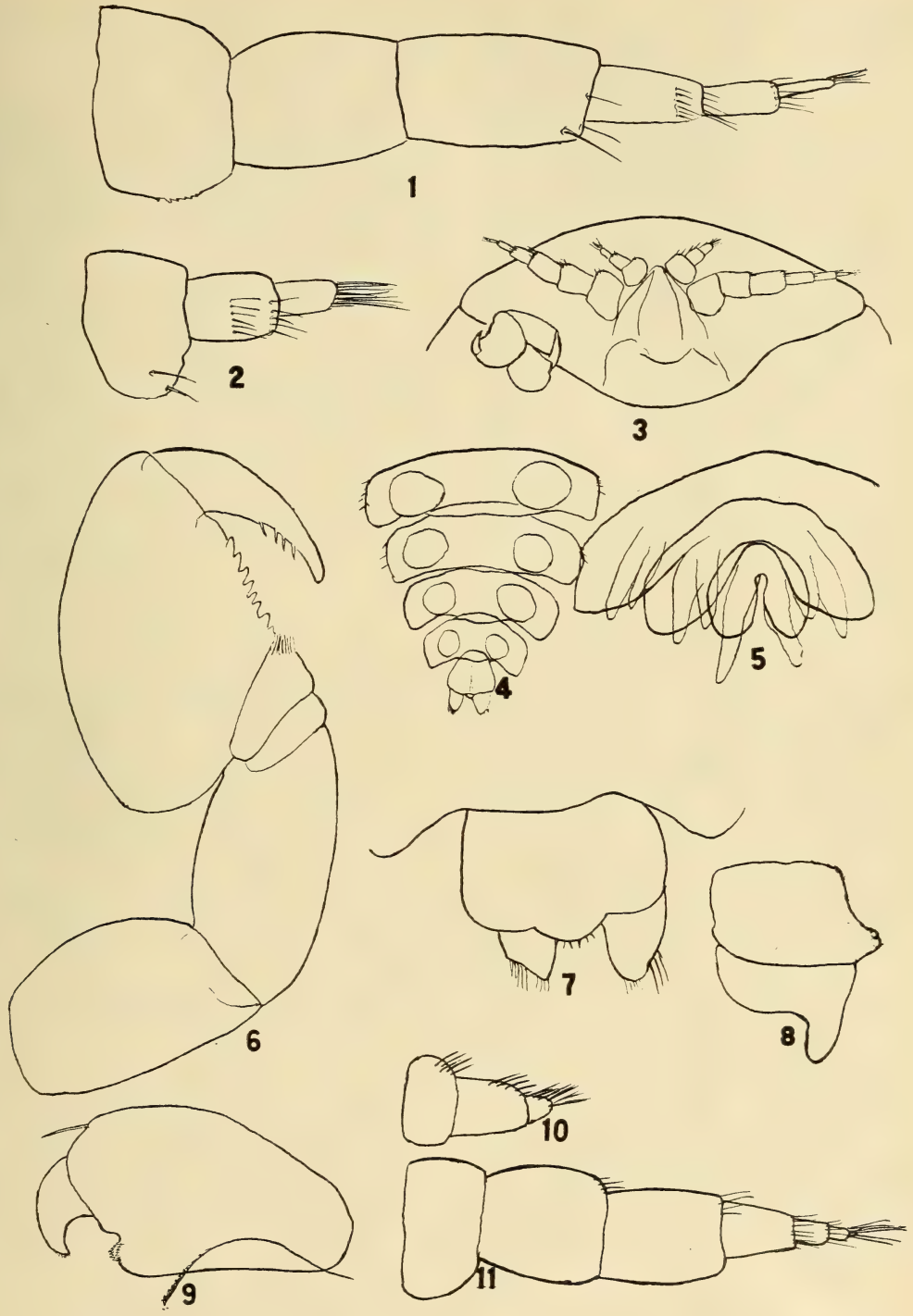
Pseudione upogebiae Hay

May 30 to August, 89 *Upogebia affinis* (Say) were examined and yielded 9 female and 7 male Pseudiones, 6 nematode worms; and in their burrows were also found 3 polyclad worms and 4 *Pinnixa cristata* Rathbun.

Pseudione panopei n. sp.

Between June 9 and July 26, 506 individuals of *Panopeus herbstii* Milne-Edwards were examined and no parasites of this species were found but on August 22, 2 large females, 3 small females, and two males were taken from the branchial cavities of 25 crabs. The holotype female (U.S.N.M. no. 82669), allotype male (U.S.N.M. no. 82670), and a paratype female (U.S.N.M. no. 82671) have been deposited in the U.S. National Museum.

Female.—Body, somewhat asymmetrical, longer than wide (13.5×8 mm; 12.5 × 8 mm);



FIGS. 1–11.—*Pseudione panopei*, n.sp.: 1, Antenna of female; 2, antennule of female; 3, head and first leg of female; 4, posterior portion of abdomen of male; 5, posterior portion of abdomen of female; 6, first leg of male; 7, telson and uropods of male; 8, first plate from incubatory pouch of female; 9, fifth leg of male; 10, antennule of male; 11, antenna of male.

flat; unpigmented. Head in a ventral view is a little longer than wide (2.2×1.8; 3×2.8 mm), slightly arched in front and deeply rounded behind; without eyes. Antennules (Fig. 2) 3-segmented and antennae (Fig. 1) 6-segmented; segments progressively narrower distally. Thorax with all segments separate; epimera on all, narrow. Abdominal segments (Fig. 5) separate; epimera flat, posterolateral angles somewhat produced into toothlike processes. The seven pairs of legs are prehensile and bear blunt teeth on the surface that meets the terminal claw. The terminal claws on the legs are progressively shorter and more robust posteriorly. The pleopods are elongate, tapering, leaf like, biramous; their lateral margins bear single rows of about 9 blunt processes on their lateral margins and are rough on their median margins. The uropods are uniramous and project one-third of their length beyond the bifid telson. Incubatory pouch enclosed by five pairs of plates, the first is 2-segmented and bears a rounded lobe (Fig. 8).

Male.—Body slender, a little less than $3\frac{1}{2}$ times as long as wide (3.3 mm×1.0 mm); bilaterally symmetrical. Head nearly twice as wide as long, rounded anteriorly and posteriorly, with a median anterior depression. Thoracic segments all separate; with flat, rounded epimera which are setose on the lateral margins. Abdominal segments (Fig. 4) gradually diminish posteriorly; the first is four times as wide as long and the sixth is twice as wide as long; the telson is about as wide as long, bears a median posterior lobe; uropods, a little longer than wide, setose at tips (Figs. 4, 7). Antennules 3-segmented, setose on median margin (Fig. 10), second segment is longest. Antennae (Fig. 11) 6-segmented; segments decrease in diameter distally and the terminal segment is minute; second and third segments longest; five terminal segments setose on median distal margin. Thoracic legs grow gradually smaller and more robust posteriorly (Figs. 6, 9); terminal hook on front leg bears 4 spines on inner margin and about 7 teeth on the penultimate segment opposite the hook; the posterior legs have short hooks and lack spines and teeth but are setose.

The pleopods somewhat resemble those of *Pseudione upogebiae* Hay, 1917, but the present species differs from that one in the number of segments in the antennae, the character and armature of the thoracic legs, the first plate of the incubatory pouch, and the telson of the male.

Cancrion carolinus Pearse and Walker

From the bodies of 506 mud crabs, *Panopeus herbstii* Milne-Edwards, 17 Cancrions were taken between June 9 and July 26. Thus 3.4 percent were infested. All these parasites were females. On July 8 four Cancrions (2 large, 2 small) were found in one crab, and on July 29 two occurred in another crab. No males were observed. Several of the females were immature.

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VOL. 37 OCTOBER 15, 1947 NO. 10

ETHNOLOGY.—*Wind River Shoshone literary forms: An introduction.*[1] D. B. SHIMKIN, Institute for Advanced Study, Princeton, N. J.

This paper sketches the main forms of unwritten literature among the Wind River Shoshone of Wyoming: the myth (in its two forms of heroic novelette and incidental story or personality sketch), the anecdote, the poetic song, the public prayer, minor invocations, and the jokes of daily life. These materials illustrate the inherent and distinctive artistry, the breadth of individual variability, and the depth of emotional expressiveness which may exist among a simple folk. My illustrations are limited by a paucity of materials and warped by incomplete knowledge of the language. They can but hint at the full richness and vitality of Shoshonean traditions, both at Wind River and elsewhere.

Other subsidiary goals exist within the framework of this essay. One is the typological delineation of the principal Shoshone literary forms in regard to structure, content, and style.[2] Another is the characterization of the relations between mythology and the rest of culture: the social setting and social functions of storytelling, the nature and variations of attitudes toward mythology, and the reflections of archaic and modern culture in the myth. A third is the indication of interactions between narrators and the tales they tell; how each narrator tends to pattern myth-stuff according to his mood, and how, in doing so, he reveals much of his basic personality.[3]

[1] Received May 5, 1947.

[2] Taylor has indicated the need for such types of study. (Cf. A. TAYLOR: *Some trends and problems in studies of the folk-tale*, Studies in Philology **37**: 1–25. 1940; p. 18).

[3] Technically, this is the "projective" technique of modern clinical psychology. Helpful references in regard to this method are H. RORSCHACH: *Psychodiagnostik*, Bern, 1921 (1st ed.); H. PRINZHORN: *Bildnerei der Geisteskranken*, Berlin, 1923; H. A. MURRAY: *Explorations in personality*, Cambridge, 1938.

MYTH AND CULTURE

The relations between myth and culture among the Shoshone are varied and complex. Partly, they are functions of the setting in which the tales are told, and of the purposes—magical, pedagogical, and psychological—which impel narration. To some degree, they result from the infiltration of mythological concepts into the fields of philosophy and religion, and the ensuing interaction. Finally they reflect the impacts of constant cultural change upon habits of thought, impacts that have yielded quaint anachronisms and conscious archaisms among these people.

On cold winter nights, old people, usually men, tell tales for the edification of young and old. Although good storytellers are generally well known and in demand, no private rights to particular stories exist, nor is there any special etiquette involving audience and narrator[4] or calling for a round robin of tales.[5] The only requirement is that a tale, once started, must be told to completion. My informant, Tassitsie, told me:

> My father, Coyote's Tail, used to tell stories. In those days, two or three young fellows would come to his tipi in the evening, in winter, give him a smoke, and ask him to tell tales. This was not for amusement but for instruction.
>
> The myths relate happenings in the days when animals and birds were people. They did various things. In time, one of the animals became old, and started telling stories; he died, another started. It is in this manner that narrators have descended.

[4] As among the Crow. Polly Shoyo, who had visited that tribe, mentioned, however, that audiences were required to say "Yes" every so often to indicate that they were awake. Other informants denied this. (See R. H. LOWIE: *The Crow Indians*, New York, 1935.)

[5] G. W. JONES: *Fox texts*. Publ. Amer. Ethnol. Soc. **1**: 3. 1907.

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Tassitsie himself, for example, told no tales while his father was alive. On the other hand, all the old people, men and women alike, can tell stories. There is neither private ownership—he knows Pivo's (another informant's) repertory—nor any correct or traditional pattern of narration.

Magical control of weather is intimately connected with the narration of myths. One should not tell stories in the daytime, lest it storm. Summer-born people alone

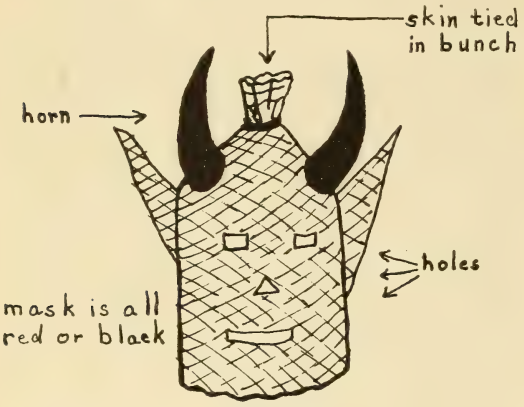


FIG. 1.—Buckskin mask.

should tell tales. If winter-born people do, it gets very cold. Tales must be told to the formal ending, and not beyond, lest it storm. The ending itself is a statement obscurely hinting at melting snow, which results from properly told tales.

Even today a great part of the education of virtually all Shoshone children is through hearing mythology.[6] No matter that some scoff at tales as idle old men's chatter: storytelling is for many the only evening diversion. In consequence, the Shoshone have become immersed in the examples and precepts set forth by mythical characters. It takes but a tiny child to recognize the word "iʒhapïŋgën" (acting like Coyote), as an expression of deceit.

The purposes which once maintained mythology as a formal instrument of instruction have largely vanished. Few any longer take very seriously the etiological explanations occurring in myths. Nor do many retain painstaking descriptions of technological processes in their stories for reasons other than conservatism or feelings of artistry. Only one very old woman, Polly Shoyo, remembered the link between mythology and formal discipline. She related that masked men would imitate the Ghost Beings in order to scare bad and disobedient children.

I saw this when I was young. In winter, in the evenings, two men would walk into the tents, all over the camp. They never rode horses. They would wear masks of buckskin; or buffalo heads, with long beards. Their bodies were cloaked in a hide with the hair on it: that of a two-year buffalo, tail and all.

Around their feet were wrappings to make them large. They held nothing in their hands.

These men were called *ʒo'aβič* (Ghost-Being). They would just walk around, without singing, without talking, scaring kids—"they're going to eat the bad and disobedient ones." All watched them silently as they would walk around the camp.

Sometimes such persons would dress like old men. In fall and winter, they'd go around the camp somehow, with white hair and masks. They might be the same ones as the others: no one knows who they are. People fed the "old men" although not the ghost-maskers. Spectators did nothing, except laugh at them.

It may be mentioned in passing that such masked impersonators of cannibals are found widely throughout North America. A recent study by Verne Ray[7] traces the distribution of this cultural complex from the Iroquois through the Northern Plains to the Basin Shoshoneans. Further diffusion of these impersonators from the Basin to the Pueblo tribes of the Southwest may also be noted. For example, among the Tewa, "tsabijc," an impersonator who goes about on certain occasions whipping the children of the village,[8] represents an unmistakable loan from Shoshonean *ʒo'aβič.

In contrast to the anecdote—on which, more later—the myth is not a recognized vehicle for wishful fantasy. True enough, mythology does relate some instances of exaggerated sexual prowess, as well as one tale of incest, that of the lecherous father.

[6] For a more extended discussion see D. B. SHIMKIN: *Childhood and development among the Wind River Shoshone.* Univ. California Anthrop. Rec. (in press).

[7] VERNE F. RAY: *The contrary behavior pattern in American Indian ceremonialism.* Southwestern Journ. Anthrop. **1**: 75–113. 1945; pp. 105–110.

[8] J. P. HARRINGTON: *Tewa relationship terms.* Amer. Anthrop. **14**: 472–498. 1912; p. 480. Cf. also E. C. PARSONS, *The Zuñi Adoshle and Suuke. Amer. Anthrop.* **18**: 338–347. 1916; p. 339.

It does idealize certain familial relations, such as that between brothers. And individuals, of course, do add particular twists and contribute special emphases to stories in consonance with their psychological needs. But Shoshone mythology is preeminently realistic. Cinderellas, male or female, do not occur in it. Its heroes are not models of human perfection; its villains often have redeeming qualities. The happy ending is not *de rigueur*.

Individuals vary greatly in the degree to which they believe myths relate real happenings of the far past or in the extent to which they integrate mythological characters into their daily religious lives. Some of my Shoshone informants, like Tom Wesaw, are skeptical of "just stories." But old people usually accept myths as true. Thus, Polly Shoyo constantly used brief tales to illustrate her general ethnographic discussions. Yet such acceptance of the historical truth of mythology has not precluded the simultaneous existence of contradictory ideas, and even of contradictory philosophies. Within mythology itself some of these contradictions occur. Several personages—Wolf, Coyote, Bat, Weasel—act as culture-heroes. Often several explanations exist for the origin of the same phenomenon. In one story Coyote originates death when he causes Wolf to die; in another he clubs his own children to death in bungling imitation of magician Beaver. But more important than such inner inconsistencies are the clashes with beliefs of nonmythological origin.

The central figure in the worship of all Wind River Shoshone cults—Ghost Dance, Sun Dance, Peyote Cult, etc.[9]—is damë'-ap:ë (Our Father), a vague, anthropomorphic, somewhat Christianized being whom all informants now identify with the white man's God. Whether the concept is completely a loan from Christianity or whether it actually contains aboriginal elements remains a moot point. Direct Wind River Shoshone contacts with white culture began in 1805, with active religious proselyting dating from 1834.[10] But it must also be recognized that Basin Shoshone and Comanche alike show the concept of a heavenly Father.[11] He appears only in a few tales, drawn in great part either directly, or through the Arapaho, from the Bible. A quotation from George Guina illustrates Our Father's position in the philosophy of several individuals:

> After death, an Indian goes to heaven. God makes him take a bath in a willow basket. The spirit now turns into a person and then goes to a camp, where he ghost-dances. While he dances, he feels good, and God says, "When they have a dance, they will be glad when they dance."

Unfortunately, the same informant told that Wolf, after reviving from death, departed, telling Coyote, "When people die, they're going to me." Is Wolf "Our Father" then? Most persons deny such a theory vehemently. But reconciliation of these fundamental conflicts is beyond their interests or abilities. One lonely individual has rejected all current religious ideas and built up his own system of belief in Coyote as Creator and God. Others, when confronted with ultimate metaphysical problems, merely say, "I don't know."

Beliefs concerning guardian spirits are virtually inchoate. A basic reason for such confusion seems to be the fact (which holds for western North America generally) that the primary religious experience is an auditory hallucination, commonly that of hearing a song. Visual imagery may be extremely undefined—"a sort of an eye," according to the experience of one of my informants—or even be completely lacking. Certain of the most powerful tutelaries, such as the Doyaratuwara plant and the ghosts of dead shamans, receive no mythological mention. But various animals, as well as monsters, occur both in vision and tale. Are such beings the mythological animals living on from the dim past or their ghosts? Are they

[9] For a full discussion of these cults see D. B. Shimkin: *Some interactions of culture, needs and personalities among the Wind River Shoshone.* Ph.D. thesis, University of California Library, 1939.

[10] See W. Irving: *The adventures of Captain Bonneville*, New York, 1848; P. J. de Smet: *Letters and sketches*, in R. G. Thwaites (ed.), *Early western travels 1748-1846*, **27**: 129–411. 1906; p. 138.

[11] See W. P. Clark: *The Indian sign language*, p. 121, Philadelphia, 1885; R. Linton, *The Comanche Sun Dance*, Amer. Anthrop. **37**: 420–428. 1935; L. Spier, *The Prophet Dance of the Northwest and its derivatives*, General Series in Anthrop. No. 1. 1935.

individual beasts or representatives of their entire species? Evidence is absolutely contradictory. Thus, Water-Ghost-Being is sometimes a specific hairy monster.[12] At other times, people affirm the existence of an entire race of such beings, male and female, young and old. Water-Ghost-Being is commonly averred to have been killed when the Union Pacific Railroad came through. Yet, in recent years, John Trehero received from him supernatural power to cure epilepsy (which the monster himself causes).

Modern Shoshone life is a hodgepodge of early and recent elements of culture. The word "dish-vessel" (dĭ'so-na-ha''u) symbolizes such anachronisms well. It is formed from the English "dish," a genitive suffix, and an old Uto-Aztecan term for cup or vessel.[13]

The same admixture found in everyday life exists also in mythology. In general, the scene of the myths seems to be that of the Wind River-Teton intermountain zone. The cultural era is the protohistoric period, when horses are just coming in (about 1750).[14] But details reflecting very different historical periods may be found even in the same myth. For example, the story of the Split Boys describes an archaic type of club, whose use in actuality had been forgotten even by my oldest informants:

> Boy is asking it from his mother: "What wood is hard?" He is asking it. Old Woman said it: "Mountain mahogany," said it. Boy is running there. He has cut it down, and is returning. [It is quite short: the bark peels off.] He is putting a good edge on one side of it, is making its handle good. At night he is drying it.[15]

The same story tells, a little later, of such a modern act as getting dishes from White people for a feast.

> Now, in the morning, Boy is running toward them: toward that place where he goes to hunt, toward White men's houses. He arrived, then said to them: "We will have a big feast in your homes." "We will have nothing to eat," they told him. "No, when your table is set with dish-vessels, the food for which you will ask (will be) coming by means of winged creatures from afar."

THE MYTH: PLOTS

Wind River Shoshone myths deal with anthropomorphic animals or monsters, and with human beings. They group themselves into two main classes, heroic novelettes and incidental stories or personality sketches. Two subdivisions exist in the heroic tales, those with elaborated and those with simple plots. Thus, out of the 21 myths from major narrators which I recorded at Wind River, 12 are heroic novelettes, 4 are incidental tales, 3 are in novelette form but specialized in content (for example, Coyote, Grease, and Bobcat) and 2 are unclassified (Cottontail Shoots the Sun, the Theft of Pine-nuts).

The *elaborate heroic novelettes* are complicated and often very long (up to 10,000 words) with plots patterned upon one basic plan. This plan includes, consecutively, an introductory phrase, the statement of a cause for starting travel, and the preparation of equipment for the trip. Then follow the trip itself and adventures en route, adventures which develop steadily in difficulty and danger up to a thrilling climax. This development forms the core of the Shoshone myth. After the crisis has passed, reasons for a second cycle of adventure emerge. Often a new, more serious purpose induces a change in the character of the once-imperfect hero. Travel, adventure, and climactic struggle come once more, but are followed now by a final victory. An explanatory element, an anticlimax, and a fixed ending wind up the tale.

The introductory phrase is stereotyped: the hero or heroes live at a given place.

> They, the noxious insects, live there all together.[16]

The reason for travel soon arises, e.g., the wish to hunt for food, raid the enemy, or search for a new husband. Now the hero or heroes generally prepare special weapons

[12] One old woman identified plate 4 of the Rorschach Test as Water-Ghost-Being.

[13] Cf. Papago ha'u (gourd cup, jicara). J. Dolores: *Papago nominal stems*, Univ. California Publ. Amer. Arch. and Ethnol. **20**: 22–31. 1923; p. 28.

[14] D. B. Shimkin: *Shoshone-Comanche origins and migrations*, Proc. 6th Pacific Sci. Congr. **4**: 17–25. 1939.

[15] (By Pivo Brown.) This is a careful translation of a text. The principal liberty taken has been to rearrange the order of subjects and objects in accordance with English usage.

[16] From Tassitsie's "Mosquito Kills Cannibal."

or magical devices. For example, Weasel's elder brother makes bows for the pair of them.

At this time, at night, Elder Brother did it, the front of this he did. Well he did it. He keeps on scraping it off all over. Having finished scraping it off all over, now he notched it. Having finished drying it, now he strings that bowstring.[17]

Travel begins, but in a leisurely fashion.

The two now, in the morning, went: in the day, kept going along. That night they arrived. In the morning, having arisen by daylight, at this time, they went—[18]

Soon, the heroes meet adventure. Successively, they must combat greater and greater but always similar difficulties. These result either from faults (mischievousness or lechery) in their characters or more rarely, from deliberate choice.

Owl's widow is so contrary as to insist on visiting Skunk's home, and on looking over the hill at the source of strange noises. As a result of both indiscretions she and her little son are killed and have to be revived each time by magician Badger, at the price of sexual intercourse. In another myth Bluejay's trickiness leads to reprisals and war.

Finally the crisis comes. In one tale, the magical elk liberated by Coyote turn into hostile Indians, and make war upon him and Wolf. In another, the Weasel brothers at last reach their destination at the "Water-Buffalo's" lair. Now ensues tense action that keeps ever increasing in emotional stress up to the dramatic climax. For example, Weasel's elder brother is preparing to capture the Water-Buffalo from beneath the surface of the lake. He tells his brother not to fear or run away, no matter what may happen.

At this time, the elder brother is coiling that rope, at this time now comes into the water. Then the younger brother has just looked at that elder brother of his. At this time, the elder brother is a walker-away in water. At this time, the elder brother, he who is up to his knees, comes into the water. At this time, the younger brother, as he keeps looking at him, now once to that elder brother said it: "My Elder Brother, enough! My Elder Brother's knee level already appears on the water!"

Then, he, the younger brother, again to that elder brother of his once said it: "My Elder Brother, enough! His waist already appears—"

Then he, the younger brother, yet again is looking toward him. Then he, the younger brother, even then to that elder brother once said it: "My Elder Brother, enough! Your neck barely sits on the water!"

Then he, the younger brother, once: "My elder brother's head appears but a little bit!"

At this time he, the younger brother, to that elder brother, once said it: "My elder brother appears no more!"

Then he, the younger brother, looked toward it, that elder brother's disappearance. Then that which is that younger brother's elder brother's disappearance place—(lo!)—beyond it is a waterspout! Then he, the younger brother, he Weasel, once: "Something indeed has eaten my elder brother."

Then he, Younger Brother Weasel, shot with his own arrows. At this time, he, the younger brother, consumed all his arrows shooting. Then he, Younger Brother Weasel, at this time is a weeper: "What could it possibly be that will, may be, keep on swallowing my elder brother?"

He now, Weasel, at this time is a weeper.[19]

As strife ends, the new situation crystallizes. Coyote's evil thoughts have led to the death of his beloved elder brother, Wolf. Coyote must recover his hide from the enemy to restore him to life. The Split-Boys, resurrected from one youth cut in half by his maternal grandmother, propose to rescue their captive mother from a cannibal giant. Often the personalities of the characters change completely as well. Coyote, once childishly jealous of his brother, frantically attempts to right his own wrong doing. Weasel, finally chastened by the grievous effects of his mischief, becomes an obedient boy, and a benefactor. Young Mourning Dove, having found his mother, is turned by her into a small child again, to facilitate their flight from Water Ghost Woman.

The second adventure parallels the first, but on a grander scale. Again there is travel, with gradual, repetitive development of incidents and events. In certain stories such repetition achieves a truly poetic balance of beauty and style. Notable indeed is an account of the Old Woman who has helped Weasel to escape from Monster Owl's island on a boat. She watches the fire which he builds in it every night as he floats away into the distance.

[17] From Pivo's "Weasel's Adventures."
[18] *Ibid.*
[19] *Ibid.*

Then she, Old Woman, is looking for it; in the night is looking for it, his red fire-making:
At this time, sees it. Then she, Old Woman, does not look for it in the day.
Then it is dusk. Now Old Woman again is looking for it, his red fire-making. Far away a tiny, red fire burns.
"Far away indeed it has become," she, Old Woman thinks.
Now again she sees it; then, in the day, does not look for it.
It is now twilight, and then evening.
It now, a twice as tiny, red fire burns. She, Old Woman, is looking for it.
She then, Old Woman, once thinks,
"It probably right now far distant has become," she, Old Woman, thinks.
Then in the day, she does not look for it.
Then it is again twilight, again evening.
She now, Old Woman, once is a looker for that wood fire.
Once?—thenceforth impossible to see it.
Then it once, may be, a red-firing barely has again become.
Red fire burns invisibly.
She now, Old Woman once,
"Right now, indeed far away, it has become," she, Old Woman, thinks. . . .[20]

The heroes meet obstacles once again. Not infrequently now such difficulties are enough to require aid from magically powerful patrons. Fleeing, Mourning Dove and her baby son find shelter in Uncle Vulture's nose, and cross a river on Uncle Crane's leg. Uncle Bat finally disposes of the pursuing Water Ghost Woman. Again, four adopted paternal grandfathers tow Weasel's boat to land, rescue the youngster from malicious dwarfs, and finally advise him how to return safely to his brother. In still another case, a friendly rattlesnake kills Cannibal's sentry to help Coyote and the Split-Boys win their cause.

At last the heroes come to their final and greatest resistance. Now begins the final, cyclopean struggle. Illustrative is Coyote's and the Split-Boy's encounter with Cannibal after the boys' mother, the monster's captive, has succeeded in throwing his bow in the fire.

Then he, Cannibal, stands there purposefully. His bow is no more. Then he Cannibal, "Double-Vulva, where is my bow standing?" said it.

She, their mother, "In the fire!" said it.

He, Cannibal, at that fireplace is looking purposefully. That little piece of his bow lying in the fire, that he takes purposefully. Toward it he keeps spitting, stretching it out. Then Cannibal, having stretched it just like that, just like a bow he tries to stretch it. Then, with his arrow, he aims.

They, the two boys, broke that bowstring a moment before he shot.

Then he again keeps spitting on it, making good that which they had kept on almost breaking.

Coyote said to them, "I myself, I will take a shot at you. You, for my arrow, would you stoop?" Cannibal stoops. It, the anus, is a big hole; there he shoots.

Cannibal, "In no way can anything be done. Let's all of us wrestle!" said it.

He, Cannibal, drags them; knives against him did nothing at all. He, one of them, "Let's make a fire," said to them. It, the fire, blazes. That Cannibal's flesh, cut off, they were throwing on the fire. It kept jumping back on the very same way, would stick back on. Then they, from whose work he felt tired, they opened his breast—his heart beats—then cut out his heart on the fire.

Back it would return from the fire, back they would throw it. It, the heart, gradually goes slower. Cannibal gradually goes slower. Then it, the heart, cooked because of it. He, Cannibal, then did not move.[21]

After the successful termination of the struggle, an explanatory element often enters. Water Ghost Woman's broken remains are the obsidian flakes that people use nowadays. Coyote's daughters, who were pulled into the sky by an arrow shot by their brother after they had committed incest with their father, become the Pleiades. Not infrequently, anticlimax follows and serves to throw a final gleam of light upon the participants. For example, when Coyote and Bobcat have ended their feud and transformed each other into their present-day selves, Coyote espies his younger brother once more. He is eating luscious wild carrots which he pulls out of the stream with his tail. Coyote, envious, pleads with him, then cajoles him into revealing his secret. However, Coyote's greediness soon leads him to grief, for his tail catches just when he tries to bring up too many wild carrots. Bobcat, from a distance, hears his piteous appeals and finally releases him magically. A mishap likewise befalls Weasel, despite his own adroitness in trickery, his heroism in fighting monsters. Coyote's bluster frightens him into relinquishing the wondrous prize of his adventures, Monster Owl's down-feather, which, donned on one's head, looks like "a mist floating."

[20] *Ibid.*

[21] From Pivo's "The Split-Boys."

And thus he comes home empty-handed.

The ending of all mythological tales is a prescribed magical formula, iʒap:e tï na (*or* a:'βi) pa:'sagai da'ʒakwagïn. The meaning of this is somewhat obscure, most likely, "Coyote way out there is tracking through slush."

The *simple form of heroic tale* includes but a single cycle of adventure. For example, a young man comes to Coyote's camp, declaring that the noxious insects have killed his people and are threatening the very existence of mankind. Coyote cooks up a scheme to combat this menace and gets the birds to help him. Then he and his followers meet the pests and destroy them, except for a few who escape in the smoke to form mosquitoes, flies, etc. The entire account is bare in comparison with the richly embroidered novelette; intentional repetitiveness for artistic effect is far less frequent. Yet the structure is almost identical: introduction, preparation of weapons, travel, fight, victory, and, often, explanatory element and anticlimax follow each other in regular succession.

In contrast to both types of heroic tale, the *incidental story* or personality sketch emphasizes the character of the central figure, usually Coyote, rather than any exciting event. The form is not rigid (except, of course, for the prescribed ending); the plot is humorous. For instance, Coyote races Dragging Hair's people. As stakes he puts up sticks, which are miraculously transformed into horses. As long as he keeps on winning, he can continue his subterfuge and afford to eat the real horses that he wins. Finally, Frog and his brothers beat him through a trick of organizing a relay of identical runners against him. Coyote must now yield his magic horses, which soon resume their wooden forms. But he learns the reason for his defeat from his anus adviser, and is soon eager to race once more. Dragging Hair's people, however, refuse to have more to do with the cheat. At times the incidental story grows in length. Thus, the tale of the Bungling Host consists of a number of incidents. But they are coordinate, show little unity, and there is no attempt to create a climax with a single artistic effect. The one unifying thread is the consistent representation of the principal character as trickster, dupe, lecher, or any combination of the three.

THE MYTH: CHARACTERS

Characterization comprises one of the most intricate aspects of Wind River Shoshone mythology. Such high development of this phase of story telling contrasts markedly with the rudimentary type of characterization found in the tales of many American Indian peoples. The automatons moving monotonously through the rigid pattern of Tsimshian tales,[22] the incredible Crow heroes[23] saved only by the tiniest of fears from impossible perfection, the weak, colorless individuals overwhelmed by the grandness of Zuñi cosmology[24]—none of these have a place in Wind River Shoshone tales. Instead, the people pictured are a complex human mixture of good and bad: rakes and saviors, cowards and heroes.[25]

The stories deal with three types of characters: anthropomorphic animals—Coyote, Bat, the Weasel Brothers, and Bobcat; monsters—Water Ghost Woman, Buttocks-Bouncer, and Cannibal; and various human beings, some named (e.g., Dragging-Hair) and others anonymous (e.g., the old woman who helps Weasel escape from Monster Owl's island). The animal characters, especially Coyote, are the most prominent. Their adventures, their jokes, their quarrels form the essential themes of Shoshone mythology. The monsters provide a constant foil of stupid villainy. The human beings are but minor actors, whose deeds may serve as prologues to the grand artistry of Coyote and his kind or, at times, fill a brief tale.

The Shoshone narrator employs distinct artistic techniques for depicting each of the three types of actors. The same animals appear time and again in various tales. The exigencies of plot necessarily demand

[22] F. Boas: *Tsimshian mythology*. Bur. Amer. Ethnol. Ann. Rep. **31**. 1910.

[23] Lowie, *op. cit.* p. 151.

[24] R. Bunzel: *Zuñi origin myths*. Bur. Amer. Ethnol. Ann. Rep. **47**: 545–609. 1930.

[25] These qualities also exist in Coeur d'Alene mythological character; cf. G. Reichard, *The style of Coeur d'Alene mythology*. 24th Internat. Congr. Americanists, 243–253. 1930.

many varying qualities and circumstances in their existence. Yet a definite core of behavior remains in every instance to mark the distinctive peculiarities of each animal actor. In contrast to the variations of animals' roles, the monsters fill the same role in every plot. Skillful variation of their personalities, however, serves to differentiate one ogre from the next. Human beings of all sorts enter the scene from time to time. Their characters and actions are not predetermined in the same way as those of the animals or monsters. Consequently, the narrator describes their emotions and their deeds quite fully in order to bring their characters into bold relief.

An examination of Coyote's personality illustrates the Shoshone treatment of animal characters excellently. On first impression he seems to change completely from tale to tale. In some myths he is the chief of the animals. In others he is the chief's younger brother dependent on him for help. In still others he lives alone, a person without prestige. His magical and personal powers are likewise quite variable. At times he is cunning and endowed with supernatural power; at others, a hopeless dupe, a weakling. His occasional bravery alternates with abject cowardice. His occasional solicitude for his kin alternates with vilely incestuous lust and childish jealousy. But further viewing of this maze of inconsistencies reveals coherence in Coyote's temperament nevertheless. Whether he is chief or outcast, it matters not, he is always ready with suggestions and orders, good or bad, heeded or unheeded. Whether he has exceptional powers or lacks them, Coyote must try to excel the rest at any cost whatever. Coyote's bravery is greatest when danger wanes; indignant refusals to perform anything more than puny deeds may incidentally save his hide. Prudence is a gentle term for his recurrent cowardice. Coyote's fondness for a younger brother does not preclude rough grumbling over a woman's ridiculous preference for that fellow instead of him. Coyote's lust is sadly transient. At one time, a moment of confusion led him to the tragic error of eating his penis, which he had left for safety's sake under his bedding. On looking further, we see the qualities which are the very essence of Coyoticism, if I may coin a portmanteau word of Coyote and witticism. Coyote is loathsome; filth and perversion are his delights. Coyote is merciless; boundless rage, ruthless murder, cynical cannibalism are his tools. Coyote is extravagant; the most senseless imitation, the most stupid negativism, and the most voracious greed and lust are his principles. Nevertheless, Coyote is a philosopher whose spirit is unbroken in the worst of adversity; heroic and idiotic, and yet superb.

To exemplify the various aspects of Coyote's character with any fullness would be to recapitulate Wind River Shoshone mythology. Therefore, a few bare references must serve our purpose. When Coyote's wife hears of the perversions the mysterious suitor practices upon her daughters, she knows he can be none other than Coyote. At another time Coyote promises to restore to good health the dancer who has been shot by some unknown person, but instead he eats him. Again, disobeying Wolf's sound advice, Coyote deliberately mistreats Rock, who chases the rascal nearly to death. In another tale, Coyote tries desperately to jump up to his daughters in the sky. His failure daunts him not at all; his sorrows fade in the hunt for something to eat.

The characterizations of other animals follow the same pattern of adjustment to specific plots and maintenance of constant traits as in the case of Coyote, but in a simpler fashion. For instance, sexual prowess is Bat's principal quality. In one story he is a very disagreeable young man. He amuses himself on a hunting trip by brutally raping an inoffensive young girl. On another occasion, he puts his ability to better use. The size of his penis fascinates a Water Ghost Woman who has been relentlessly pursuing Bat's sister and her little son (the monster's erstwhile husband). She demands coitus, but —alas!—Bat's vigor kills her. Bat's powers now result in the rescue of mother and son, and the bequeathing to mankind of the obsidian flakes into which Water Ghost Woman's body breaks.

Shoshone monsters are physically powerful, magically endowed, and invariably hostile to man and human animals. They

are fast runners and vicious fighters. True enough, they are stupid and easily distracted from their designs, but their innate suspiciousness and the magical talents which they or their assistants possess make them ever dangerous. Their chief concerns are food—preferably human flesh—and sexual intercourse; but, rarely, they may indulge in playing and wrestling among themselves. Yet even they have merits. Their habits are orderly, and their manners toward their intended victims are usually most polite.

Differences of personality exist even among monsters. One Water Ghost Woman is brutal, nay, sadistic. Sardonically, she calls her baby victim "my dear little daughter's child," before she tortures him by burning. Then she tears off his head. Later, she murders a woman by beating on her breasts with a green switch until death quiets the agony of her prey. Another Water Ghost Woman is a much gentler soul. When she gets her chance to steal a baby boy, Mourning Dove's son, she does not kill him savagely. On the contrary, she takes him home to raise as a husband, a procedure which, true enough, takes but little time. She merely stretches his penis to proper size—and presto!—he's a young man.

Soon this young man must hunt food for his monster wife. While hunting, he meets his uncle Eagle, who tells him the facts about his abduction and his mother's unceasing longing for his return. Eagle also gives the youth instructions and magical implements to help his escape from Water Ghost Woman. Following this advice, young Mourning Dove eludes his jealous mate's close surveillance and flees to his mother. Soon, Water Ghost Woman is in hot pursuit. At first she wishes to punish only the mother:

"Darned old Mourning Dove is stealing my husband away from me. I'll club the female!" says she, Water Ghost Woman.[26]

She suffers many mishaps in her chase, and endures many hardships. Only the defecation of her trusty anus, which at other times merrily keeps breaking wind as she runs, "Xʷ! Xʷ! Xʷ!," can overcome the magic barriers which she encounters. Her temper grows ever worse. Slowly, she realizes that she is being scorned: old passions inflame her rage. Slowly she realizes she is being tricked: new injuries increase her fury. As a consequence, the next time she sees Mourning Dove and her son, she shakes her club and yells at them from a distance.

"I'll really do right by you! We were the best of married couples—! You two probably believe yourselves about to be safe, while actually, I myself, will keep on hitting you thus!" she, Water Ghost Woman said.

After a long and eventful flight, Mourning Dove and her son take refuge with Bat, her brother. The latter lays a trap for the pursuing ogre. When Water Ghost Woman has tracked the couple to Bat's house and is interrogating him concerning their whereabouts, he pretends ignorance. As he talks, he calmly proceeds to pound his penis with a hot rock. The sight of such unbelievable potency banishes all thoughts of her old lover from Water Ghost Woman. A new, burning passion arises within her. "Maybe you will copulate with me?" she, Water Ghost Woman, said it. But Bat refuses. He copulates with no one; a hole in a hot rock nearby serves as his wife. Now Water Ghost Woman becomes frantically eager indeed, "Yes, all right, copulate with me just a wee bit!" The tragic results we already know: pleasure, utmost satisfaction, pain, death, destruction. This is the reason that obsidian flakes rather than amorous female monsters are now found in the mountains.

The characterization of human beings proceeds in two typical ways: the development and illustration of personal traits by the unfolding of a plot, and vignettes of human emotion. The story of a man's feud with a Water Ghost Woman illuminates the first method:

A man, his wife, and their child camp out by themselves in a country infested with monsters. They have little to eat, so that, when night falls, their child keeps crying from hunger. The parents try to still it, but fail. Then they abandon the infant in the center of the tent, and hide in a far corner. Soon a cannibal comes, tortures the child, murders it, and then carries it off.

This atrocious act spurs the child's father to action. The next day he goes scouting for the monster's lair. But fear conquers his desire for

[26] From Tassitsie's "Mourning Dove Rescues her Child."

revenge, and he returns without achieving his purpose. When he comes home, he finds that his wife, too, has been Water Ghost Woman's victim.

The second tragedy surpasses human forbearance. The erstwhile coward now braves all dangers in his frenzied grief, and finally succeeds in avenging himself on the cannibal.[27]

A vivid description of human reactions occurs when Split-Boy directs his paternal grandmother to kill him (so that, unknown to her, he may be resurrected as a pair of twins). She protests violently but finally does the deed.

Then (he) said it to that Old Woman: "That with which you will club me is this. You, then, right after having clubbed me, will cover me well." He said that; now he hands it over. "Old Woman, all right, hit me!" said it.

Old Woman holds it up. "To kill him with whom I stay, my grandson,—" having thought (this), (she) refrained. "I might kill him with whom I have my home," she thought, still refraining.

Her grandson thinks: "She didn't hit me in any way at all—"

Then his grandmother hit him, killed him. Then Old Woman covers him, that boy, well. Old Woman faints in horror. Old Woman in the night awakes crying, falls asleep in horror.[28]

But when the old grandmother, early in the morning, sees that two live Split-Boys have formed out of her dead grandchild, she becomes deliriously happy. They ask her to tell Coyote of their plan to rescue their mother, but not to tell him they are now two. And so she goes on her way.

Old Woman goes along "da—da—da—," "gan—dan—da—"—(humming and singing in her joy).

Coyote hears her and suspects something. When she speaks to him she stutters, and her tongue slips into a tell-tale plural rather than the dual.

"My . . . my son's child is saying it: Tell Coyote, let's, all of . . . —us two, try to go after my father's killer right away."

THE MYTH: LITERARY DEVICES

Artifices of sound and of meaning are employed by narrators to enhance the beauty and dramatic vividness of their tales. They flow from six main sources: play on sounds, play on sequential devices, variations of expression, visual imagery, appeals to emotions, and special devices of mythical significance.

The *play on sounds* involves two phases of artistic endeavor, the patterning of the normal speech-sounds and the use of special sound effects to add particular vividness. The patterning of speech-sounds is intimately connected with the phonetic peculiarities of the Shoshone language. The consonants are simple: spluttering velar, lateral or glottalized sounds do not occur. Furthermore, consonants can not combine into clusters. Tonguetwisters of the typical Crow sort are therefore absent.[29] The constant alternation of consonants and vowels, the phonemic differentiation of two vocalic lengths, and the regular patterning of three distinct degrees of stress infuse Shoshone with a distinct rhythmical swing.

In general, the initial vowel of each verbal stem in a word is stressed, with secondary stresses on succeeding odd vowels. This, of course, follows the old Uto-Aztecan pattern,[30] which is noticeable in its most rigid form in Southern Paiute.[31] In Shoshone, many true and apparent exceptions are to be found to this rule, so that regularity does not crystallize into monotony. For example:

surë mba′hanï wï‘ uʒa′wašaru¹in¹ gë′tankʷ//
pënurëʒa′wašaru′in¹ sur wupi′xʷ//
(They, the father's sisters now are swinging him hard; he whom they are swinging leaps off.)[32]

Speakers of the language clearly appreciate its melody, for the rules of good elocution, in myth-telling and oratory alike, demand a smooth, continuous flow of words elided into one another.[33] They demand a flow that pulsates in waves of ever-rising pitch, and is broken by the metronome of stress. They permit no stoppages or changes in that flow, or, in fact,

[27] From Tassitsie's "The Feud with the Cannibal."

[28] From Pivo's "The Split-Boys."

[29] Cf. Lowie, *op. cit.*

[30] B. L. Whorf: Amer. Anthrop. **37**: 600–608. 1935.

[31] E. Sapir: *Southern Paiute, A Shoshonean language*. Proc. Amer. Acad. Arts and Sci. **65**: 1–296. 1930; p. 39 ff.

[32] From Pivo's "Weasel's Adventures." The orthography follows strict Americanist usage.

[33] In normal Shoshone speech final consonants followed by initial vowels in the succeeding word are treated like intervocalic consonants, being subjected to various elisions.

phonetic contrasts of any sort, as media of artistic expression.

The small number of initial consonantal phonemes and the paucity of basic stems result in constant alliteration in Shoshone. Quite typical is the following phrase:

su''ni sur yï'gwïnïd yi:k dë'a kwïd//surewï'' ukwïdak sit sɔ'gupɜa'nak^{w}//su'khwent surëdë'a urëna'yanuk urëna'yanu'kiar.

(When it has become evening, again she defecates. As she was defecating, it was the earth that mended. From there, she again is tracking them, is their tracker.)[34]

On the other hand, various phonetic rules in regard to the sonancy, spirantization, and other alterations of intervocalic consonants save the tongue from monotonous cacophony. This is an especially dangerous potentiality in Shoshone, which uses reduplication as a normal grammatical mechanism. Thus it is that theoretical "mi'mian" and "do'do'in^{i}" become "mi'-ẉian" (they went) and "do'ro'in^{i}" (they are climbing).

The combination of rhythmical and alliterative qualities in the language makes the narrator's emphasis upon rhyme wholly natural. Most descriptions, even by one so artless as Charley Nipwater, are in rhymed prose.[35] An illustration will make the point clear.

pa:'rhi du:'parhi mu'ɜambia so'guria ɜuk^{w} hu'-kaβagia na'yïgwït

(Elk, moose, mountain sheep, mule deer, Virginia deer, in the willows may they be!)[36]

The special sound effects are either formal jugglings of words or imitations of natural noises. In the former category are such nonsense words as "e:'βimɔ'mɔgusɔ," Coyote's magic name (an English approximation of this might be clay-nose-ose), as well as puns and similar plays on words. Puns, however, are typical of every-day joking but not of myths. An instance of mythological punning occurs, nevertheless, on the occasion of Blind Coyote's finding that his two female companions were named Waving Person and Sage-Brush Girl. "Strange," he said, "some people call me Waving Pretty-Boy, and others Sage-Brush Pretty-Boy. So we should be together, for our names are the same."[37]

The imitations of natural noises are an integral part of the Shoshone language but to a small degree. Outside of interjections, onomatopoeia has originated only a few verbs, e.g. wɔ'wɔ-, to bark, and nouns, e.g., šu'akwakwa, robin. Most other onomatopoeic words, e.g., hi:'to, meadowlark, are really remnants of a Plateau Shoshonean past.[38] On the other hand, unformalized imitations abound. An example of stuttering has been noted on a previous page. Baby talk also occurs to give coy effects.

ik ba:'bawuci dë'as uyu'yuhuci ëm ba'bawiči be:'kapuci

(Here's an 'ittle bit of water and some itsy-bitsy fat from your buddy's 'ittle kill.)[39]

The Shoshone teller of tales does not even disclaim to imitate plain noises. He mimics the sounds of beasts, monsters, and particularly birds: Mourning Dove as she sorrows for her lost son, and pipsqueak Meadow-Lark[40] as he gives aid to the enemy. He strains the capabilities of the human voice to give the sound of a knife as it slits a throat or of an anus as it breaks wind.

The ordinary *sequential devices* of Shoshone myths are four in number: parallel development to a climax, simple reiteration or repetition, sharp contrast, and parenthetical incorporation. As has been shown before, parallel development is the principal characteristic of plots, although reiteration is used in at least two ways. Characters relate adventures *in extenso* to others, either before or after their occurrence. Also, the plots of the longer incidental stories are largely repetitive. The anticlimaxes so common in tales exemplify contrast. Since virtually all details contribute directly to the development of the total plot the parenthetical incorporation of incidents is less usual than the other devices. Exceptions in a certain sense are the unessential elabora-

[34] From Tassitsie's "Mourning Dove Rescues her Child."

[35] As in the constant rhymed prose (es-Saj') of descriptions in classical Arabic belles-lettres.

[36] From Charley Nipwater's "Coyote Liberates the Animals."

[37] From George Guina's "Blind Coyote."

[38] Cf. E. Sapir: *Southern Paiute dictionary* Proc. Amer. Acad. Arts and Sci. **65**: 537–730. 1931; p. 557.

[39] From Pivo's "Weasel's Adventures."

[40] Exact ornithological identifications are not available.

tions of the emotions of minor human actors and the somewhat similar lavish descriptions of tools.

The structures of incidents within plots abundantly illustrate all four types of sequential devices. Parallel development is ubiquitous; the main form in which it occurs is the description of a series of actions in time. The Shoshone language makes such temporal seriation particularly tempting by offering the narrator his choice of many slightly differing suffixes of tense and aspect. Consequently, constancy in the stems used and variation in the suffixes easily and concisely create parallelisms. A textual example illustrates the superiority of Shoshone to English in this respect: Weasel's adoptive grandfathers start, in turn, to tow his boat.

suβe sur pa:'nʒux ba:'gar wītī'gwax sum tu:'nkunt gë'karix//*uge'yagunaik*^{w} (1) suβe sur sa:k *gunai'k*^{w} (2)// suβe *uge'yagunai'gant* (3)//suβe sur *ba:'rukaigunaigïn* (4) sur sa:k *ba:''aβaigunaigïn* (5)//sur pa:'nʒux suβe *gwa'yax* (6) suβe sur *gwa'yaβit* (7)//bitus su'βa sa:'kiwa ma'rtoro'ïn[i]

(Then he, Mink, hits the water with rope in mouth. He *sped chasing it* (1); then it, the boat, *sped* (2). Then he *is in the state of speeding in chase of it* (3). Then he *is speeding under water* (4); then it, the boat, *is speeding on the water* (5). Then he, Mink, *tires* (6); then he *is one who is made tired* (7). Again, he is hoisting himself up on the boat.)[41]

Parallelism in logical or causal sequences occurs with less frequency. Typical, however, is the following instance:

It is he, Coyote, who is not eating; through not eating he starves.[42]

Repetition is also a very important artifice. It forms, of course, an essential part of the parallelisms and is also relished for its own sake. Most activities and phrases must be repeated four or five or ten times, according to individual taste. Repetition in the form of enumeration is popular. Thus, a frightened man has run to tell Coyote:

"They now—they who are mosquito-fly, big-fly, gray-fly, black-fly, yellow-fly, all dangerous—are arriving at my people's home."[43]

[41] From Pivo's "Weasel's Adventures." Shoshone and English parallelisms are underscored and similarly numbered.

[42] From Tassitsie's "Coyote, Grease and Bobcat."

[43] From Tassitsie's "War with the Mosquitoes."

Furthermore, the narrator often stresses important facts before and after their results. This happens when Water Ghost Woman has bullied Uncle Vulture into revealing the whereabouts of Mourning Dove and her son.

He now, having felt fear of her, is relating it: "Already I, myself, in this way, blowing my nose, have snorted them far away." This is that which he is relating, having felt fear of her.[44]

Contrast forms a part of several descriptions of actions. Coyote, for instance, runs up the mountains chasing mountain sheep, then down again; then up again, and so on until he is exhausted. Only one type of contrast, however, seems to be an integral part of Shoshone style: antithetical orders, with the negative preceding the positive injunction. Weasel's Elder Brother furnishes an illustration as he directs the youngster, preparing for their trip.

"You, having gone—that obsidian over there is worthless; two buttes beyond it, there now it's all good—from there you will now fetch much, all you can carry."[45]

Similarly, Weasel's adoptive grandfathers tell him.

"You will in no possible case whatsoever sleep in a straight burrow," (they) told him, "and you will sleep in a crooked burrow."

The incorporation of parenthetical ideas is characteristic of many passages. Here, as in the case of parallelism, the Shoshone language is largely responsible. Polysynthesis combines many elements into a single word, which the speaker can readily analyze e.g., *u-gë-rï-ka-'ma-xwa-c*, equivalent to ten long English words, "having just finished destroying something (or someone) invisible by eating with teeth." Syntax also permits the loose joining of such catch-all words to the substance of the sentence by prefixed personal pronouns. It matters little that the logical connection must often remain obscure. One may translate "urëmi'wiak—wï' du:'wunaix" by "as they are walking—because they are walking—, in their walking—, a black spot appears." Syntax likewise permits demonstratives to assume relative functions; a single, compound demon-

[44] From Tassitsie's "Mourning Dove Rescues her Child."

[45] From Pivo's "Weasel's Adventures."

strative may tie two or three independent clauses. For example, Coyote directs:

Ke gëmbu"it ke dë'as wë'sëgĭndar! *su'kura* bu"iha dë'as wë'sëgĭndai gu'tido!

(Don't be lookers or peekers either! *At him whosoever* might either look or peek someone will shoot!)[46]

Finally, even completely disjointed flows of thought are but extensions of good Shoshone usage. Thus, when Coyote has started his Circle Dance, he watches the participants,

"It is he now—as they are dancing the foremost one of them appears fat—he is now looking at that fat one."[47]

The principal *mechanisms for achieving variety of expression* are synonyms, metaphors, similes, and special phonetic and syntactic alterations. Only the first of these mechanisms will be discussed here. A later section on visual imagery will take up metaphors and similes. Among the Shoshone the non-functional phonetic and syntactic alterations are devices of poetry and not of prose. Consequently, the section on poetic songs will deal with them.

Synonyms of slightly differing meaning abound in Shoshone. They may have entirely different stems as in some nouns, e.g., *"nɔ:r"* (ridge), *"dɔ'ya"* (mountain), and innumerable verbs, e.g., *pï'di* (to arrive), *gim* (to come), *gɔ"i* (to return), *ya 'i* (to enter), *dɔ 'i* (to enter or go out). They may simply vary suffixes. For instance, many interchangeable verbal suffixes express continuous action, e.g., *mi' ano:* (he keeps on going), *mi 'axant* (he is in the state of going), *mi' agwai* (he is gone, and will be gone indefinitely). Nouns, pronouns, adverbs, and adjectives may also receive modal suffixes for emphasis or depreciation, e.g., *nï'ʒa* (I, indeed), *nu:'në* (I, perhaps). They may change from independent words to adverbial or adjectival prefixes of the same stem. Semantic differences often accompany such changes. The word "na'riand" (dangerous), for example, combines with the verb meaning "to fall," and yields a compound *na'ria'ani-* (to faint in horror); but it also combines with the verb meaning "to cause to think," and yields a compound *na'riasu'aŋg-* (to esteem). Finally, they may form completely different grammatical structures. Thus, emphasis may be expressed by suffixes of many sorts added to the words stressed, or by the use of the negative particle and the unreal mood. An illustration of the last method is the following: *nï'ʒa ke ha'gap ëngai"iwait* (It is impossible that I shall not be a stayer with you, i.e., I will remain with you at all costs.)

The Shoshone narrator and his audience are extremely interested in words as such, and extremely appreciative of good usage and accurate shading. They demand both idiomatic and exact expressions. For example, Guy Robertson, an older and more conservative man, scornfully rejected Lynn St. Clair's anglicized description *tom'boniwaiki* (in a circle) as an innovation for the correct *gu'na hɔ' ig* (around the fire). Both narrator and audience quickly grasp the delicate nuances of thought expressed by slightly differing synonyms. Almost every expression, every word, indeed, may have its peculiar connotation, unique, yet lucid. In short, variety of expression, especially when coupled with parallelism, is a main artifice of the Shoshone litterateur. It is an artifice, however, which no outsider can truly appreciate; translation grasps its shadow, not its substance.

Visual imagery accentuates important aspects of the action or background of a myth by making them especially vivid and picturesque. The Shoshone narrator uses three types of such imagery: direct descriptions, metaphors, and similes; pantomime is an occasional accompaniment of anecdotes. Descriptions of emotional scenes and of tool-making are very common, as preceding pages have shown, but other descriptions are exceedingly rare. Thus, there is only one representation of a landscape in all my material. Its simple beauty makes quotation worth while. When Weasel and his brother approach the "Water-Buffalo's" lair, the narrator describes the scene thus:

Here is water
Here is the Water Buffalo's lair,
Here is blue-edged water
Here many trees are standing.[48]

[46] From Tassitsie's "The Hoodwinked Dancers."

[47] *Ibid.*

[48] From Pivo's "Weasel's Adventures."

Simple metaphors abound in Shoshone myths. Most of the animal characters are called both by their ordinary names and by descriptive terms, some of them derogatory. For example, Beaver is sometimes known as Big-Tail Owner; Bat, as Tobacco-Black-Mouthed One; Coyote, as Daylight Anus. Actions also may be metaphorically depicted. For instance, when Bat runs fast, he "becomes a white streak." Similes occur less frequently than metaphors. Some of them are unimaginative: When Weasel's Elder Brother reproaches the youngster for having disguised himself in Cannibal's skin, he says, "Even if I be like a woman (because he had become panic-stricken and shot at the supposed monster), it is one who might kill someone."[49] Other similes, however, are exceedingly picturesque, e.g., hospitable Owl's piercing of his eye causes nutritive liquid to "flow from it like egg yolk."

It is hard to know what emotions myths arouse in Shoshone audiences. Only direct observation can tell us. The *emotional significance* of a given incident may be very different to them and to us. Elsewhere, I have told how two of my informants found great amusement in a very grim account of a murder.[50] Where most of us would only have seen horror, they saw ridiculousness. Because of these differences in reactions, I will discuss here only those manifestations which I have actually seen.

Humor is an important characteristic of Shoshone tales. To achieve it, the narrator most often establishes ridiculous situations, relates pranks, tells obscenities, or plays on sounds. A rarer technique is irony, which may be illustrated by Weasel's conversation with Monster Owl. The boy is gorging himself at a forbidden hour, while she watches him silently. He offers her some meat, then taunts her for not taking it:

"Why, are you going to become sick, having come to me on purpose?"[51] She claws at him suddenly, but he avoids her, and scoffs, "You're clawing as though for a husband!"

Most listeners find the battle scenes of the tales tense and exciting. They are sympathetic toward such mothers as Mourning Dove, who yearns for her lost child, or such brothers as Weasel, who fears for his brother's safety. Coyote's perversions and vilenesses arouse revulsion in some.

Few special *devices of mythical significance* are found in Shoshone tales in comparison with those of many other peoples. The recitatives of the Southern Paiute[52] and Eskimo[53] have no parallels among the Shoshone, nor do the special voices and intonations peculiar to Nez Perce myth.[54] The mythological era is not emphasized as distinctive by the use of any special, indefinite mythological verbal aspect,[55] or the habitual use of a quotative—"it is said"—[56] or by specific reference, e.g., "already only a short time away the human race comes."[57] No special mythical sentence structure exists.[58]

To be sure, Shoshone myths do have some artifices of this type. There are special mythical names for some animals. Weasel is called "pë'përanz ugupë" (which I cannot analyze) rather than the usual *pa:'βiži*. Various fantastic beings likewise have unanalyzable names, e.g., *gip*, a "water-buffalo," and *honowikhono*, a "buttocks-bouncer." Some, like the Water-Ghost-Beings, make characteristic noises, e.g., *wi:ho*! In addition to the peculiarities of name-giving, the myths have a stock of stereotyped actions and situations. Illustrative of a whole series of awakenings from death is the following incident. Bat has restored Coyote from death by frightening him with his magical arrows. The latter does not appreciate the true situation, and grumbles:

"Darned Bat, Tobacco-Black-Mouthed One! When I had been sleeping well, he woke me up," Coyote said it.

[49] *Ibid.*
[50] SHIMKIN, "Psychological Studies, etc."
[51] From Pivo's "Weasel's Adventures."
[52] SAPIR, "Texts, etc.," p. 414 ff.
[53] K. RASMUSSEN: *Iglulik and Caribou Eskimo texts.* Rep. 5th Thule Expedition, 1921–24, **7**: (3). 1930; p. 36ff.
[54] A. PHINNEY: *Nez Perce texts.* Columbia Univ. Contr. Anthrop. **25**: 1934; p. 10 ff.
[55] M. LEENHARDT: *Le temps et la personalité chez les Canaques de la Nouvelle-Calédonie.* Rev. Philosophique **62**: 43–58. 1937.
[56] E. DELORIA: *Dakota texts.* Publ. Amer. Ethnol. Soc. **14**: 1932, p. 1, n. 2.
[57] PHINNEY, *op. cit.*, p. 26.
[58] Z. HARRIS and C. F. VOEGELIN: *Hidatsa texts collected by Robert H. Lowie.* Prehistory Research Series **1**: 173–239. 1939; pp. 231–232.

"No. You were not sleeping. You were killed. Look at your hide," (they) said it. Then as he looked at his own scabby hide, he felt badly.[59]

Other stereotyped actions are reviving a comrade from death by rasping a wild rose branch[60] vigorously in his mouth or anus, killing a monster by shooting him in the anus with a firedrill, fooling a monster with flies in a pot which buzz like human voices, or taking refuge from him by shrinking magically and hiding in a friendly relative's nose. A final device of mythological importance is the persistence of some animal characteristics in the personalities of the main actors. Thus, Badger can burrow underground and Kingfisher can fly.

THE NARRATOR AND THE MYTH

An understanding of the relation between narrators and the myths they tell demands study of the nature and degree of changes introduced in tales by different tellers, and the extent of correlation between such changes and various personal idiosyncrasies. Ideally, research into this relation should include, on one hand, a wide sampling of tales collected in text, with numerous fully comparable variants, especially from key individuals; and, on the other hand, thoroughly documented sociological and psychological data concerning the tellers and their places in the community.[61] Our materials fail lamentably to achieve this ideal. As a matter of fact, the comparable variants included in them were taken, unfortunately, in two different languages, Shoshone and English. Truly accurate stylistic comparisons were thereby made impossible. Seven informants on mythology out of a population of eleven hundred souls represent only a minute sample. Furthermore, none of the collections from these informants is by any means exhaustive.[62] Finally, while the sociological and psychological data concerning the informants are relatively abundant, they are largely incomparable from individual to individual, and are often impressionistic. In short, only the importance of the subject justifies the following completely tentative presentation.

Variations in the stories follow one principal line of cleavage according to the status of the narrators. The sections of this paper have been based upon the works of my major narrators, George Guina, Moses Tassitsie, and Pivo Brown. The stories of such minor narrators as Polly Shoyo, Pandora Pogue, John McAdams, and Charley Nipwater are but simplified and abbreviated reflections of the better and fuller versions. They differ from the better versions in reducing plots to one or two incidents, in simplifying characterizations into such single, absolute qualities as malice or greed, and in avoiding stylistic elaborations other than repetitions of actions and descriptions by enumerating details. They may even omit the magical formula for warm weather.

A comparison of two versions of Blind Coyote shows clearly the attrition which tales suffer at the hands of a minor teller. The version of major narrator "A" is as follows:[63]

Coyote learns from some chickadees the art of throwing his eyes at trees to fetch luscious wild-carrot roots. Unfortunately, he forgets the directions that the birds have given, and throws his eyes at a fir tree, where they stick henceforth. Blind Coyote now wanders helplessly on the prairie until, by accident, he runs into two girls. He strikes up an acquaintance, and goes with them. The girls see some buffalo and ask him to shoot them. He, not wishing to let them know he is blind, says, "Yes. When you see me far away, you can drive the buffalo toward me." Then, when they are far away, he starts shooting everywhere and anywhere, pretending he can see. By chance he kills one beast.

The girls return and see the arrows sticking in the ground all around him. They pull them out, give the arrows to him, and ask him what he has

[59] From Pivo's "Bat Hunts Mountain Sheep." Compare this stereotyped situation with that found in Wintu myths, cf. D. Demetracopoulou and Cora Du Bois: *A study of Wintu mythology.* Journ. Amer. Folk-Lore **45**: 373–500, 1932; p. 380.

[60] This plant was formerly placed on the chests of the deceased when they were interred.

[61] Such studies have long been a basic objective of the Russian Folkloristic school. For brief discussion of their methods and results see M. Asadowskij: *Eine sibirische Märchenerzählerin.* "F F Communications," No. 58, Helsinki, 1926, pp. 5–23; J. M. Sokolov: *Sovetskii Fol'klor,* Moscow, 1938, esp. pp. 34–123.

[62] Further data on all these individuals will be found in Shimkin, *Psychological studies,* etc. in his *Wind River Shoshone Sun Dance* (Ms.) and in his *Dynamics of Wind River Shoshone history.* Amer. Anthrop. **44**: 451–462, 1942.

[63] Arbitrary letters have been substituted for personal names.

been doing. "Counting my arrows," says Coyote. Then they notice the dead buffalo, and tell him of it. "Well, didn't I promise to shoot one for you?" responds Coyote nonchalantly.

Similarly, Coyote fumbles his attempt to butcher the buffalo and to build a hut. Each time he covers his error by a wisecrack. Finally, Coyote asks one of the girls to louse his head; while she does so he falls asleep. Soon the girls, curious to find the cause of his quaint antics, raise the band on his forehead. Worms are crawling in his purulent eye-sockets. The girls flee from this horrible sight.

When Coyote awakes he follows the girls in all haste. But one of them throws her rattling ornaments over a cliff. Coyote follows the noise, falls off the cliff and breaks his leg. From the top of the cliff the girls watch him and mock, "Look at Coyote, he's broken his leg." Indignantly, Coyote replies, "What are you girls talking about? I'm just eating mountain-sheep meat."

After a while, a chickadee helps blind and crippled Coyote by making him a new, wooden leg. Coyote now travels in search of his older brother, Chief Eagle, whom he eventually finds. Eagle soon discovers Coyote's trouble and puts a mountain-sheep's eyes in the empty sockets, thus restoring the sight. The recovery makes Coyote so happy that he starts howling in joy, as coyotes have done ever since.

The variant of minor narrator "B" shares with this the introductory incident, the travel with the girls, their flight, and Coyote's chase and fall over the cliff. But it fails to develop the humorous possibilities of blind Coyote's doings, to introduce smoothly the discovery of his blindness or to explain plausibly the girls' cruelty toward him. Furthermore, it ends abruptly, leaving Coyote at the bottom of the cliff, failing to explain how he recovers his health. The tale is neither finished nor humorous, lacking artistic and etiological point.

As Coyote is going in the brush, he hears a noise: "Eyes! eyes!" He peers and sees Porcupine. He asks the latter what he is doing, and Porcupine answers: "I throw my eyes at the red-willow tree, and they return, bringing me wild carrots. That's how I get my living."

So Coyote imitates him and lives very well for a while. Eventually he forgets Porcupine's instructions and throws his eyes at a yellow willow. They stick to it (there they are yet).

Coyote finds two girls as he is traveling hiding his blindness with a rawhide cap over his eyes. He lifts the cap and asks the girls what is wrong with his eyes. The girls see worms, are horrified, and want to leave him. He insists on following them, saying, "You just rattle the bells on your blanket."

"Yes," they reply, and throw the blanket over a cliff. He follows the sound, falls over, and breaks his leg. He gets a stick, rams it into his leg to get at his own marrow, which he proceeds to suck. He says, "Look at what I am eating."

But the girls continue on their way.

In general, the minor versions are but poor editions, without originality or artistry. They may be attenuated to the point of retaining but one detail out of a long narrative. For instance, minor narrator "C" isolated the encounter of Grease and Coyote from the entire elaborate story of Coyote, Grease and Bobcat. Such extreme attenuation may also result in a secondary, jumpy recombination of the fragments, as in narrator "D" 's jumbled miscellany of four myths (The Hoodwinked Dancers, Blind Coyote, Wolf and Coyote, and Porcupine crosses the River).

Coyote starts the Ghost Dance. When Coyote begins it, they dance for a week. All of a sudden, he goes blind, having thrown his eyes at some trees, which have warts to this day. He goes around with a buckskin over his eyes. Finally, his wife says, "What's wrong with you? You go around feeling everything." When he falls asleep, she lifts the bandage and sees worms in the sockets. So she says, "No wonder you're blind. What happened to your eyes?"

Coyote awakes and replies that he threw them in the brush.

Eagle, Coyote's mother's brother, ponders: "That boy can't see. I'll try to rustle him a pair of eyes." So he flies away to kill a mountain-sheep and take out its eyes. These he puts in Coyote (that's why coyotes have eyes like those of mountain sheep).

After his sight is restored, Coyote gathers all the animals in one place. He gets up and announces, "What will each of us be? Everyone name what he will be."

Porcupine decides to be a porcupine and kill with his quills. He kills buffalo by crawling inside them and piercing their bellies. Then he eats them.

Lesser differences occur within the two basic groups of major and minor variants in the tales. Those existing in the stories told by major narrators are worth analysis.

All the major narrators are perfectly cognizant of the structural requirements of properly told tales, the outstanding traits of the principal characters, the significant happenings of mythological times, and the most popular literary devices. These factors they hold surprisingly constant. They feel free, however, to vary their combinations,

to embroider the basic patterns in various ways. Through such variations, apparently minor, arise considerable differences in the artistic unity and effectiveness in the total emotional and ethical flavor and in the rounded psychological pictures of the actors. For example, narrators "E" and "A" recounted the basic elements of the story of Owl's Widow identically.

Because her husband, Owl, is stingy with food, she kills him by planting a poisoned rabbit bone on which he steps. Before his death, he implores her, on their little son's behalf, not to marry his brothers Skunk, Badger or Coyote, all of whose children are mean and would kill the boy, but to marry youngest brother Sparrow Hawk, a bachelor. After she buries her husband, Owl's Widow goes on her travels. Immediately, however, she disobeys her deceased spouse's injunctions by visiting Skunk's home. However, Skunk's mother warns her to leave at once, which she does. Unfortunately, she drops a piece of her shawl which Skunk notices on coming home. He becomes infuriated that Owl's Widow has dared leave him, and pursues her and her son, but cannot reach them on the slippery ice. Just as they are escaping he kills them with his stench.

In some way, magician Badger learns of Owl's Widow's death and goes in search of her. After finding her, he restores the woman and her child to life. Then he gives her good advice. She pays him for his services and goes on to Sparrow Hawk's home. Having arrived there, she is greeted by Sparrow Hawk's mother. Soon Sparrow Hawk himself comes home with but one little rabbit. Once he has brought his game, he flies away to his nesting place on the cliff.

Meanwhile, Owl's Widow doubts the wisdom of her choice, for Sparrow Hawk seems to be a poor provider. Coyote, coming by, scornfully reinforces her doubts. She, however, finally puts the rabbit in the ashes to cook. Behold! the single rabbit has quadrupled. All eat, and still there is much left over.

This wonderful feat reassures Owl's Widow, who now follows her new mother-in-law's instructions. When night has come, she climbs up to Sparrow Hawk's nest, and embraces him. He yells mightily, so that Coyote, running up toward the source of the noise, starts shooting arrows at the intruder. However, Owl's Widow smears mucus on her mate's face, which immediately quiets him. Coyote, coming within sight, sees what they are doing, shrugs his shoulders, and goes home.

Narrator "A" added several details to his version. Badger's fee for his services is sexual intercourse. Owl's Widow disobeys instructions again, is killed again, and revived again for the same fee. In addition, Narrator "A" does not introduce Coyote's insulting remarks about Sparrow Hawk's hunting ability until after the successful mating. The insult leads to a quarrel, in which Sparrow Hawk shoots a fire-drill into the ground, setting the earth on fire. Coyote burns and Sparrow Hawk relents. This ends the story. Narrator "A" 's additions underscore Owl's Widow's obstinacy and stupidity. They allow more elaboration of erotic detail. His transposition, however, materially weakens the story, which shunts aside its main theme and main actor to end disjointedly in an anticlimax.

Narrators "E" and "A" told the story of the Bungling Host in a very similar fashion. But the former's version allows Coyote the return of one of his children from death, and ends the tale, not with a fight between Coyote and Mountain Sheep, but with Waxwings telling Coyote's wife that the fool would return with four little waxwings after his guest's departure. These two changes give "E" 's tale a kindly and humorous rather than a sardonic cast.

Finally, "F" 's and "A" 's renditions of Weasel's Adventures provide strong contrasts in the development of the plot, the flavor of the story and the character of the hero. The principal theme, of course, is the same.

Weasel and his Elder Brother go hunting the Water-Buffalo. On the way, despite his brother's objections, Weasel encounters and kills several monsters, pushing one off a cliff, defeating another in a wrestling match, and destroying a family of them by throwing them off a swing. Finally the pair gets to the Water-Buffalo's lair. The elder brother swims under water after the beast. Weasel, watching from shore, becomes hysterical from anxiety and flees into the sand hills, where he dies of thirst. When the elder brother returns with the slain beast, Weasel is no more. However, two grandfathers, who are passing by, come to the rescue, find Weasel and restore him to life. Before leaving, they warn the two brothers against building a fire in the locality at night, lest Monster Owl see it. Nevertheless, hungry Weasel does so that night, and is kidnapped by Monster Owl for his pains.

In "F" 's version, however, Weasel's trickster character is made far more explicit than in "A" 's by introducing such escapades on the hero's part as pricking the testicles of an unsuspecting grandfather with sharp-pointed grass. In "F" 's version, likewise, the encounter with Monster Owl is

heroic, with Weasel killing the bird by a stratagem; in "A" 's, it is mock-heroic. Two mouse-grandfathers drive Monster Owl from his perch, kill him with smoke, and then extract Weasel from his belly. After that, they revive the bird by rasping his throat vigorously with a wild-rose branch. He awakes, and grumbles that he has been roused from an excellent sleep. Then, all the characters part amicably. Finally, Weasel's transformation of character after leaving Monster Owl's island occurs only in "F" 's tale. "A" has no parallel to "F" 's account of Weasel's new obedience, new benevolence and new timidity, nor of the reconciliation with his brother.

In brief, "F" 's manner of narration is far more mature than "A" 's. It stresses the development of the hero's character and his gradual chastening by experience. It is well integrated and dramatic at the same time. It utilizes a great range of incidents and artistic devices. In contrast to this, "A" 's version emphasizes events rather than characters. It has no moral implications; in fact, its tone is rather flippant. It uses the same tricks and the same buffoonery time and again. Artistically it is incomparably less mature.

What individual differences of environment or temperament lie behind differences in story-telling ability? My limited data suggest three categories of concomitant variations: correlates of marked educational (acculturative), intellectual, and temperamental differences.

The poverty of "B" 's tales seems primarily to reflect his limited knowledge of Shoshone traditions and artistic standards. He is half white; he has received some school training, and has worked for the Agency and other white employers at various times. He has traveled extensively. Consequently, though he has retained many typical Shoshone beliefs, he has also assimilated ideas from other sources. For example, he interlarded an intelligent and authentic account of various Shoshone ceremonies with a description of the Hopi Snake dance. In like manner he often confuses various facts of Shoshone culture. Thus, in construction and style his mythological tales are almost indistinguishable from his versions of the fantastic, often pointless, boastings and stories of wonder which comprise the Shoshone anecdote.

"D" and "A" furnish a contrast especially in intelligence. In their responses to the Rorschach Test they manifest a few likenesses and many differences. On one hand, they share a synthesizing but pragmatic approach to experience; neither of them attempts an escape from reality by yielding to excessive concern over minutiae or by negativism. Furthermore, inner drives, conscious or unconscious, appear to activate them but feebly. These narrators are both genuine extroverts who find their significant stimuli in other persons or in their environment, not in themselves. Neither is sharply analytical or critical in outlook, and consequently, both are somewhat over-expansive and over-impulsive. On the other hand, "D" is, in comparison with "A", far less active, far less responsive to stimuli of all sorts and much more set in her ways. (Her age, one must remember, is over eighty; "A" 's approximately half as great). She is mentally stereotyped and unimaginative. Possibly, she would persevere in her narrative and imaginative habits even more doggedly than she does, had she greater energy. He is mentally more alert. His responses are varied and, within the limits of ordinary ability, rather imaginative and original. She is emotionally rigid; her emotions come in outbursts. He is emotionally pliable, his modes of expression run the gamut of friendliness, sensuality, and sheer, uncontrollable passion or rage. Finally, she shows few signs of anxiety. He, however, has many worries, some of which he seems to have solved rationally. Others are still active, and appear to give rise to moderate hypochondria. In short, both "D" and "A" are ordinary, normal human beings. But "D" is inactive, stolid and dull; "A" active, sensitive and original, but of smaller mental stature than either "F" or "E". The differences in the story-telling ability of these two persons appear largely to arise from differences in their intellectual ability.

The differences between "C" and "F" are of a complicated nature. Both are highly intelligent people who can express themselves very well indeed. "C" excels in her

ethnographical narratives and her anecdotal stories, such as the one concerning the Weakling and the Female Bear, which are as fully descriptive, vivid and elaborate as the best mythological tales. "F" related an absorbingly interesting autobiography as well as the best versions of the myths. How is it, then, that the two differ so greatly in the quality of their myths?

To the best of my knowledge, the difference reflects that between their basic personalities. "F" has led a satisfied and happy life; he has achieved love, honor, and power. In his old age he is quiet, relaxed, and wise in the ways of the world. He has mastered discipline and tradition; he has learned the tales to perfection. Now, as an adept, he can mold them at his will, infuse them with his wisdom and with the warmth of his personality. So he points out morals, delineates truly living characters, and softens the brutal harshness of the myths. But since he has had many outlets to his energies throughout his life, he does not seize the myth as a means of emotional expression. He detaches himself from its context; calmly he polishes his tale to balanced, clearcut beauty. It is a beauty of age and warmth and kindness; it is not a beauty of stark, searing-hot emotion.

"C", on the other hand, has led a life of extremes, of great happiness and complete gloom. She was loved and protected by her grandmother; she was abused and beaten by her husbands. Her children died young. Discipline has passed her by, and outlets of achievement and satisfaction have been denied her. Consequently, her emotions control her, drive her. She talks restlessly, incessantly; she has little use for formal rules of storytelling. Quickly her keen mind recalls the point of an obscure tale crucially bearing on her argument or her complaint. Instantly she tells it, stripped naked of all dross. She cares not at all that others fret at the invitation to stormy weather she has thus introduced. Or she may pause, describe with great fidelity, with infinite care, the tiny details of daily life impressed upon her very soul by years of arduous toil; or dwell on tender memories of dauntless warriors who stirred the heart, of beauteous fops who stormed yet other parts—then, in an instant, drop it all, grumble about the damned world's worries and then be off once more. In just the same way, she alternates joyful, hopeful tales of marvelous aid to the unfortunate with sardonic, gloating anecdotes of suffering and death. She swings from uncritical, naive belief to hard-boiled cynicism. Is it any wonder that the strict formalism of Shoshone mythological tales has failed to catch her restless spirit?

ANECDOTES

In addition to the myths proper, the Shoshone relate a mass of inchoate tales that may best be classed as anecdotes. Essentially they are realistic stories believed to be true and concerned with human beings. In contrast to the myths they are often precisely localized. The wondrous happenings which occur in them are all within the ken of Shoshone reality: anthropomorphic animals are rarely mentioned. Anecdotes have no recognized literary form (as verified by versions in text).

Such tales are the especial delight of young men. Many of them are personal adventures, often picturesque "whopping" lies not meant to be believed. Braggadocio is frequently evident, especially in tales of great erotic feats which resemble in content and psychological role the limericks of modern American culture.[64] Attitudes toward these tales vary. Most men relish them, but some, especially those who have been most imbued with White moral teachings, are embarrassed to hear them. Rarely, a more serious motive enters. Lynn St. Clair told me how one man defended himself when accused of murder. He had gone through the dry country near Owl Creek with his friend, but only he had returned. He gave the following story.[65]

They had been hungry and thirsty. Finally, they came upon a big rattlesnake. His friend killed it and thought that they might eat it. The first man refused and walked ahead, reaching a spring.

The other followed, still holding the snake. When he got to the spring he cut off the snake's head. He skinned the snake and cooked the

[64] W. LaBarre: *The psychopathology of drinking songs.* Psychiatry, **2**: 203–212. 1939.

[65] This is a widely spread Plains story in attenuated form.

meat. It was nice looking, so he offered some to his companion (the narrator) who refused.

When they went to bed, after one had finished his snake, the other slept apart because he was afraid. After a while he heard a rattling from where his friend was, so he moved farther away. This happened several times. In the morning he looked, but his friend was nowhere to be seen; he had turned into a rattler.

No one believed this story, however, and he was accused of murder. Yet no action was taken. Many years later some Bannocks saw an enormous rattlesnake at the very spot of his story. The accused seemed vindicated.

In general, the boundary between belief and disbelief in regard to anecdotes is vague and shifting. To illustrate this fact, an examination of one narrator's attitudes is helpful. He told this in all seriousness.

My wife, my boy and I went out camping' hunting elk. In the night I dreamed I couldn't kill an elk. Just couldn't get him. The next day I shot all my cartridges at a spike buck. He stood still, but I couldn't hit him. I asked my boy for an ax, and finally got (killed) him. I dreamed about a woodchuck the same way. Now I won't go hunting.

He told this as a joke:

One fellow told me, 'My friend, you know what I did once? I was sweating in the mountains. I saw a creek, took off my clothes, then crawled into the water, leaving my clothes behind. Finally I heard a little noise. There was a bear, with all my clothes on. He had a gun in his hand, and was pointing it at me. I said, "Partner, you ought not to do that. Better take your clothes off." So he stripped and I dressed again. I told him, "You wait." I got a bridle, put it on him, and rode him until I reached my house!

But this again was serious fact:

One of my uncles was a bear charmer. One time my uncles got to chasing a bear which got away from them. They talked brave. "Bring that bear out by the ear," said my uncle. None would do it. He, Ed Bazil, then went into the brush, and found the bear lying down. He told it, "I'll take you to the people." And he led him out by the ear. He wouldn't kill it and the people were afraid to. So they let it go.

In terms of origin these anecdotes may be grouped as follows: narratives of the work-a-day world, tales of supernaturally endowed persons and supernaturally dangerous localities (based on current religious and superstitious concepts), myths from the Plains, and modified European fairy stories.

A good illustration of the first class is the story Tassitsie volunteered after we had been discussing smoking customs for some time:

One time we were moving away from Owl Creek along Big Wind River, among the big cottonwoods. We young fellows would all go in a bunch and surround rabbits, shooting them down with arrows. It happened this time that another fellow and I killed none.

We rode some distance, then came upon four old men sitting down, facing the east. They were He-cries-in-the-night, Na'šawiki, Dear-little-big penis, and Horse's-Mother's-Father. They asked us if we had killed any rabbits; we said "No."

We lingered a little. Then one of these men wanted to smoke. He said, "Someone fill a pipe for us and let us smoke." He-cries-in-the-night had a pipe, strange, rough and unfinished, but quite large. He filled it up.

Dear-little-big-penis took off his moccasins. There was some grass there. He pulled it out to make the ground smooth. He drew a ring and dug a hollow in the middle. Then he asked for a match, but none of the men had one. So he reached down in the quiver and drew out a fire drill hearth: on its edge were three or four round holes, blackened. He took a drill out of the quiver.

They coaxed one another to make the fire. Two fellows held the hearth finally, while Big-penis twirled. He took some tinder—where from I did not notice. Then he tore some off another large piece. About the fourth time, they said, "Now the fire has dropped on to the tinder." Dear-little-big-penis picked it up, started blowing. He lit the pipe and started smoking. Then he handed the pipe toward his right to He-cries-in-the-night.

The men had been sitting on a bank of hardened snow above a gulch. Now He-cries-in-the-night smoked for quite a while. He started wobbling. The next man snatched the pipe away, but He-cries-in-the-night fell over the ledge to the bottom.

They kept on smoking; paid no attention to this. After they were through, Dear-little-big-penis took the pipe and dumped the ashes into his ring. He worked them in until they disappeared. They now told Na'šawiki, "What happened to our friend? You go and see." They then cast the work on to each other for quite a while. Finally, after Dear-little-big-penis had put on his moccasins, he got up to see what happened.

They saw a puddle of blood. He-cries-in-the-night had fallen on his hooked nose, and skinned it badly. He had fainted. Dear-little-big-penis picked him up and tore the skin off his nose. The others stood around joking. He-cries-in-the-night came to, then washed his wound in a warm spring fifty yards away.

Afterwards his nose turned black.

Tales of supernaturally powerful persons tell of their acquisition of power, of their

relations with their patrons, or of the miracles such persons can perform. For instance, the great chief Washakie received power from the dwarf *nïnïmbi* after rescuing him from attack by an eagle. This incident is one of John McAdams' favorite anecdotes. Again, Tassitsie was much impressed by his friend Gun-Owner, a snake charmer.

The two were going on foot by North Fork. Suddenly Gun-Owner said, "Friend, I have left my dog here. I don't know if he's still there." He stopped by a rock pile, where Tassitsie saw a rattler, and ran away. A little later Gun-Owner caught up with him, and once more the two walked on. When they had gone a little way, a rattlesnake's head suddenly peeked from beneath Gun-Owner's blanket. The snake saw Tassitsie and began rattling, but Gun-Owner held on to it calmly. Then the two crossed South Fork, and ended their walk. Now Gun-Owner grasped both jaws of the snake and stepped on its tail; now he handled its fangs, showing them to Tassitsie. These were easily pulled out, he remarked. Having pulled the fangs, he let the snake go.

Finally, Polly Shoyo told a remarkable incident:

This is a true story. I knew a man named Sticky-Hair. Once, he took off his moccasins, stirred the ashes of the fire place, placed his moccasins in it, and covered them with ashes. Then he lay down to sleep. A little later he asked his wife to look at the moccasins. They had turned to buffalo tongues!

Of all sacred places, Bull Lake, "Water Buffalo's Crying," was the most feared. Many lost their lives here to the monster in the lake. Well known, in many variants, is the following account:

Two friends came to Bull Lake. They saw a bull come out of the water; they killed it. They made a fire, cooked some of the meat on it, and started eating. One man ate only a little, and slowly. The other kept on cooking the meat and eating it.

They were sitting back to back, one facing the lake; the other, the mountains. The former let out a bellow like a bull. The latter, frightened, ran up the hill. Soon the former arose and walked into the lake, right into the water. That was the last ever seen of him. (Polly Shoyo)

Typical Plains myths involving human characters seem but elaborations of these Shoshone beliefs concerning supernaturally powerful persons and supernaturally dangerous localities. Representative of the Plains myths found at Wind River is the story of the woman and the buffalo bull. Well known from other tribes, it need not be repeated here.[66]

European fairy stories are not at all uncommon among these people. Unfortunately my records of them are fragmentary and haphazard. The adjustment of fairy stories to Shoshone tastes and habits can only be hinted at. Thus, John McAdams identified the story of John the Bear,[67] which he had heard in New Mexico, with the local tale of the Weakling and the Female Bear. He had pruned away all incongruous elements.

Bears in hibernation store choke cherries and all kinds of roots, just like pack rats. People have seen this. One Shoshone came as a lone survivor from a war party, freezing and starving, into a bear's den. He saw something like lights (these were the bear's eyes) and he heard growling, but he laid himself down beside the bear, and she liked it. So he wintered there.

In the spring, however, she continued to keep him prisoner, blocking the entrance of the cave with a big rock whenever she would leave. Once she was careless, and he was able to squeeze out and escape.

After running for a long while he came to some of his fellow tribesmen who would have nothing to do with him until he washed and cleaned himself with mud, for he stank like a bear. Just then the bear came, pursuing him. The man's life was saved by the war chiefs, who surrounded the bear, and killed her.

Dick Washakie knows the Indian.

I heard the same story from New Mexico with the difference that it was a male bear who impregnated a girl. Finally, she escaped when her son, at ten years, had grown large enough to handle the rock barring the entrance of the cave. The bear, trailing her, was killed by the Mexicans, who ambushed him. The little cub was just like a human being, but stout. He's still living.

I've never heard of animals other than bears having intercourse with people.

[66] E.g., R. H. Lowie: *The Assiniboine.* Amer. Mus. Nat. Hist. Anthrop. Pap. **4**: 1909; p. 213.

[67] The principal sources on John the Bear are S. Thompson, *European tales among the North American Indians,* Colorado College Publ., Language Ser., **2**: 319–471. 1919; *idem, Motif-index of folk-literature* **1** (F F Communications No. 106, 1932); J. M. Espinosa, *Spanish folk-tales from New Mexico,* Mem. Amer. Folk-Lore Soc. **30**: 31–49, 1937; and R. F. Benedict, *Zuñi mythology,* Columbia Univ. Contr. Anthrop. **21**, pt. **2**: 32–35. 1935. The basic Plains story of the weakling and the female bear is also given in R. H. Lowie: *The Assiniboine,* Amer. Mus. Nat. Hist. Anthrop. Pap. **4**: 1–275. 1910; *idem, Chipewyan tales, ibid.* **10**: 194–5. 1912.

POETIC SONGS

So far as I know, true poetry occurs among the Wind River Shoshone only in songs.[68] Most of these are meaningless vocalizations, as in the Sun Dance, war songs, and Peyote songs, but some have intelligible verses. To this latter class belong Ghost Dance, mocking and gambling songs, as well as songs with popular American tunes but Shoshone words. Unfortunately, I have examples of only the Ghost Dance and mocking songs from the second class.

Elsewhere, I have discussed Sun Dance songs in some detail;[69] war songs are much like them. A brief text will illustrate the typical vocalizations of Peyote songs. They are sung during the ceremony with the accompaniment of a gourd rattle shaken about one hundred and sixty times a minute. They are sung in a distinctly falsetto voice; accented phrases rise sharply in pitch, whispered ones drop:[70]

ɔ′haninini ɔ′haninini
ɔ′haneni yana ɔ′haneni yana
ɔ′haneni
yanawe:′ yanawe:′
ra′ra yuwanuyana hininuᵉ

The Ghost Dance, which the Shoshone call "Shuffling" (Na′rayar) is a simple ceremony performed during the winter months at full moon, and two or three nights thereafter. Its purpose is to shake away illness. Other, closely related dances, such as the Warm Dance and the Father Dance, have such functions as improving the weather and averting disaster.

As evening comes a fire is built. Often a pine tree is set up close to it. A leader stands by the fire and sings without accompaniment. Another replaces him when the first tires. Around the fire and the leader is a ring of dancers, men and women alternately. The dancers dance clockwise, dragging their feet sidewise, holding hands with intertwined fingers. Their only special article of dress is a blanket with which they shake away illness. This shaking and a ritual pounding of breasts normally conclude the rite. Periodically, however, and even in recent years, fainting, messianic frenzies, and prophecies have taken place during the performances.

The singers are shamans who dream or or compose their songs. The music is a mere alternation of two themes of simple structure and narrow tonal range sung slowly in a high-pitched, nasal voice. The texts are cryptic descriptions of visions, fully understood only by their authors.[71] These texts are built up of units of single lines which rhyme through simple, final repetition, through alliteration or assonance, or through true rhyme. Two varieties of Ghost Dance texts exist, one, which simply repeats each line, and another, more complicated in structure, which repeats each verse. Some examples follow.

Yellow willow is waving
Yellow willow is waving
Grass, big grass is waving
Grass, big grass is waving
Alder is waving
Alder is waving, etc.

Again:

Sage-brush goose's son
Sage-brush goose's son, etc.

Representative of the second group is

White-rock rivers
All kinds of rivers
Warm rivers (Repeat whole verse)

A final example shows some interesting peculiarities. This is a song dreamt by a powerful shaman now deceased, Frank Perry.

pa:′rutï′mbi
pa:′ruẓïga:″yu
pa:′šoni pe′ŋgwinux
pa:′ŋgë maβi′

Water-black rock,
Water-black shining;
Two water-grass fishes
On the water's edge.

In this instance meter and stress are well balanced. The lines are of five, seven, seven,

[68] Shoshone poetry is very simple compared to such sophisticated types as those of the Navajo. Cf. E. L. Walton: *Navajo song patterning*, Journ. Amer. Folk-Lore **43**: 105–118. 1930.

[69] Shimkin, *Wind River Shoshone Sun Dance* (MS).

[70] Musical studies of Winnebago and Kiowa Peyote songs by Frances Densmore and Jane Richardson Hanks, respectively, exist in manuscript form.

[71] Compare the shamanistic songs given by Kelly and Natches for the Southern and Northern Paiute. Cf. I. T. Kelly: *Southern Paiute Shamanism*, Univ. California Anthrop. Rec. **2**: 151–167. 1939, p. 159, and G. Natches: *Northern Paiute verbs*, Univ. California Publ. Amer. Arch. Ethnol. **20**: 243–259. 1923; p. 259.

and five morae, respectively. The stresses are on the second and fourth, second and sixth, second and fifth, and second and fifth morae. But such balance is accomplished only through poetic license. In normal Shoshone the adjective precedes the modified noun; the suffix *a'yu* is short and unaccented; intervocalic *m* becomes a nasalized *w;* and so on.

In function and structure the mocking songs differ profoundly from the Ghost Dance songs. The former were composed and sung by gangs of young warriors in derisive serenades of fops who neither worked nor fought in battle, who indulged in extravagances of adornment such as the artificial lengthening of hair with horse hair glued on with pitch, and who—worst of all—could entice all women. The young men would go as quietly as possible in front of the fop's door. Then, suddenly, they would start drumming and singing at the tops of their voices. The music resembles that of the war songs but, unfortunately, I have recorded none of it. The text of one mocking song sung by Tassitsie is as follows:

ën ŋga'nhi tų'iwiči
mak në hu:'awain^{i}
ke ën o'ar ndo'iwaix^{w}
mak në hu:'awain^{i}
ën ŋga'nhi tų'iwiči
mak në hu:'awain^{i}
ke ën o'ar ndo'iwaix^{w}
mak në hu:'awain^{i}
a'ya hanž dičir gwë'kant
nan mawi:'yahant
dɔ'yawant no:'mia'^{yu}
keha në:'cidë^{i}
ëŋgwë' gwë'pain^{i} në wiža wën'
du'koβ^{i} utuwek'

You('re) at home, Pretty Youth,
While I a-foresting go
Nowhere to did you go out,
While I a-foresting go.
You('re) at home, Pretty Youth,
While I a-foresting go.
Nowhere to did you go out
While I a-foresting go.
Oh Friend! Bad husband!
Just as well to keep her tied,
Among the mountains (you) keep on moving:
Won't you be ill?
(With) your wife for a wife I would stand,
A black face, bringing it.

The structure of this poem is quite regular, the odd lines having seven morae; the even, six. The even lines, furthermore, are, with the exception of the last, uniformly accented on the third (double) mora. Actually there are three verses here, the first two having the same refrain. The ninth and tenth lines rhyme, while the other pairs of lines share an identical final accentuation.

The term tu'iwiči, basically "youth," has a connotation of foppishness and excessive elegance in direct address and in proper names (cf. pu'hutų'iwiči, "Sage-brush-pretty-youth"). The word gwë'kant, literally "wife-owner," is poetic license for gu:'xapë (husband). The "black face" refers to the facial paint of a warrior who returns from combat after having achieved a battle honor or coup.

THE PUBLIC PRAYER

Public prayer comprises the most serious and majestic phase of Shoshone oratory. It takes place especially in the Sun Dance and the Peyote ritual. It is for the public good, to achieve the release of someone or of everyone from illness, to give them long life, or to accomplish successfully some ritual act, such as cutting down the tree for the Sun Dance outer pole.

Stylistically these prayers (which are not fixed in form) maintain a similar pattern. They begin with an invocation: "All right, my Father, having looked down on us from above . . . " Then follows a statement of the suppliants' condition: they are about to kill the sacred buffalo, to chop down the tree for the outer pole or they are here with a sick man. After this passage the prayer itself, e.g., "May you make him well." Often a prayer for spectators or the populace at large follows, with its statement of condition and its hope. Finally, comes "it is ended."

The prayers of some individuals differ. Quitan Quay is curt and omits the invocation. The prayer which Dick Washakie thought he might give was marked by its highly personal character.

Inasmuch as several of the texts appear elsewhere,[72] a single illustration will suffice for the Sun Dance prayers:

All right, My Father, having looked down toward me from above, by means of you I achieve a benediction. I make a supplication. Here is now a sick man, may you make him well! My

[72] Shimkin, *Wind River Shoshone Sun Dance.*

prayer to you also Our Elder Brother Jesus: save him! The person whom you bless, for him your blessing is great. All right, I supplicate. That is all.

The Peyote prayers are peculiar enough to deserve more extended quotation. Gilbert Day prays in this manner on entering the tipi at the beginning of the ceremony:[73]

Our Father, looking toward us, and Our Elder Brother, "lower spirits," all together having looked toward us, may they pity us!

The first person plural here ("exclusive," i.e. "they and I") seems, as in other prayers, to have a general meaning, "everyone." The concept of "lower spirits" is peculiar; I know nothing more concerning it.

After midnight a recess takes place in the ceremony, and the paraphernalia are cleaned at this time. A water-bearer brings in a bucket from which all drink. Then, following some other ritual acts, the equipment is returned to its place, and the leader of the meeting goes outside to blow his whistle to the cardinal directions. He may also pray. Gilbert Day gives a sample text. After an introduction similar to that above, he says:

Eastward steadily, its breeze keeps blowing
Southward, its breeze keeps blowing
Westward, its breeze keeps blowing
Northward, its breeze keeps blowing
All well, here inside let them become!
Finished.

MINOR FORMS

Even every-day life is by no means lacking in little formulas, plays on words, and other elements of unwritten literature. A few examples will give some idea of their use.

When one wishes help from a noted shaman he must address him in a fixed way. With Moguca, Lynn St. Clair tells me, one must say

Prayer-Boy,[74] I have just come for (you); pray for one of us right away!

Then one hands him three dollars and he accepts the case.

Or again, when a child loses a deciduous tooth, he goes to a wildrose bush, digs a hole under it, and drops in the tooth. Then he mutters the following formula:

Wild Rose, you thrived well; in just this way my tooth should grow.

Finally, clever remarks may arise on any social occasion. When I was giving some Rorschach tests, a young man, Meyers Coopooie, cracked this pun on seeing the first plate:

hiniwič u—s hɔ'nɔwič
What is it—'tis Bat!

Members of the household roared with laughter.

CONCLUSIONS

1. The folk literature of a simple culture may be surprisingly rich, varied, and developed. Consequently, in assessing the total achievements of cultural groups with scanty material culture and loose social organization, considerable attention should be paid to their mythology and allied forms of artistic and philosophical expression.

2. The richness of Wind River Shoshone literary forms indicates that comparable developments may exist among the other Plateau Shoshoneans. The meager records available for those groups are no proof to the contrary, since they have been collected largely in English, and often with poor interpreters.[75] Steward's tales imply original mythological forms of considerable length and complexity. Sapir's main informant was a schoolboy, who admitted imperfect knowledge; St. Clair's and Marsden's materials are incomplete and poorly translated. Obviously, a great deal more exploration of this potentially rich field should be undertaken.

3. Among the Wind River Shoshone, the myth, the poetic song, and the public prayer comprise the finest forms of verbal expression. The primary function of the myth is the edification of the audience, while poetic songs are either social, or mystical in character, as in the case of the Ghost Dance songs.

4. On the basis even of incomplete and imperfect materials, it is clear that significant correlations exist between the styles of narrators and their individual personalities.

[73] I have presented the elements of the Wind River Shoshone Peyote Cult in pp. 104–121 of O. C. Stewart: *Washo-Northern Paiute Peyotism*, Univ. California Publ. Amer. Arch. and Ethnol. **40**: 63–136. 1944.

[74] This is an unusual term for shaman. The ordinary word (bɔ'xagant) means "owner of supernatural power."

[75] See J. H. Steward: *Myths of the Owens Valley Paiute*, Univ. of California Publ. Amer. Arch. and Ethnol. **34**: 355–440. 1936; E. Sapir: *Texts of the Kaibab Paiutes and Uintah Utes*, Proc. Amer. Acad. Arts and Sciences **65**: 299–535. 1930; H. H. St. Clair, MS. in Bureau of American Ethnology, etc.

BOTANY.—Veronica connata *Rafinesque.*[1] Norman C. Fassett, University of Wisconsin.

In his *Scrophulariaceae of eastern temperate North America,*[2] Dr. F. W. Pennell took up the name *Veronica connata* Raf.[3] for the plant that he had previously described as *V. catenata* Pennell.[4] This species, he wrote, is the only member of the group in western Kentucky, where Rafinesque had stated that *V. connata* was found, and the description is excellent except for specifying connate and entire leaves, whereas the plant to which Dr. Pennell applies the name has clasping and slightly crenate-serrate leaves.

Prof. M. L. Fernald[5] rejected Rafinesque's name as "very incorrectly or erroneously described and wholly doubtful . . . which was assigned perfoliate and entire leaves such as are not found in our plant." He concluded that the earliest valid name for the species was *V. salina* Schur.[6]

Unfortunately these opinions are more or less subjective. Dr. Pennell emphasizes the parts of Rafinesque's description that apply well, and minimizes those that do not, while Dr. Fernald dwells upon the mention of perfoliate and entire leaves. The question seems to resolve itself into whether Rafinesque might have called the leaves of the plant in question connate and entire.

That the leaves clasp the stem with their bases in contact but not connate is clear from plates 582 and 583 of Professor Fernald's paper, provided only that one has previously examined actual plants under a lens. The writer submitted these plates to several of his colleagues, who are not familiar with the plants, asking, "Are they connate or only clasping?" All agreed that it was hard to tell; several thought that some were connate, especially those of figure 1 on plate 582. Had Rafinesque had such an individual perhaps he would have been justified in calling the leaves connate.

Examination of figure 1 on plate 582 suggests that Rafinesque might well have called the leaves entire. Some of the margins are undulate, but there is scarcely a *bona fide* tooth shown. On the same plate he might have seen at least four unmistakable teeth just above and to the right of the "2." From a study of plate 583 he would probably have decided that the leaf-margins were toothed. These plates represent very well what one finds in examination of actual specimens: the margins of the leaves range from definitely toothed to weakly undulate and practically entire.

If, as Dr. Pennell believes and Dr. Fernald does not, Rafinesque was describing the plant in question and erred in calling the leaf-margins entire, his error was independently repeated by many subsequent botanists with more enviable reputations for accuracy. Robinson and Fernald in edition 7 of Gray's *Manual of botany* describe the leaves of *Veronica anagalis-aquatica* (including the species here under consideration) as "serrate or entire"; Wiegand & Eames, in the *Flora of the Cayuga Lake Basin,* key *V. Anagalis-aquatica* var. *glandulosa* (cited by Pennell as a synonym of *V. connata*) under "leaves entire, or obscurely crenate-serrate"; Rydberg, in the *Flora of the prairies and plains,* describes the leaves of *V. catenata* (the name later thrown by its author into synonymy with *V. connata*) as "finely serrate or entire"; Steyermark, in the *Spring flora of Missouri,* specifies for *V. connata,* "leaves . . . smooth-edged or short-toothed"; and Dr. Pennell's original description of *V. catenata* reads "crenate to nearly entire."

As Dr. Fernald notes, this species occurs in a glabrous western phase and a glandular eastern phase. Dr. Pennell's map shows this clearly; the two phases intermingle in those two problem regions, the Ozarks and the Driftless Area. It is somewhat surprising, then, to see Dr. Fernald treat these two phases as forms rather than varieties. The present writer, perhaps because he received his botanical training from Professor Fernald, has held to the principle that intraspecific variations showing geographic segregation are best treated as varieties,

[1] Received May 19, 1947.
[2] Acad. Nat. Sci. Philadelphia Mon. **1**: 365. 1935.
[3] Med. Fl. **2**: 110. 1830; emended in Atl. Journ. **1**: 150. 1832, and New Fl. N. Am. **4**: 37. 1838.
[4] Rhodora **23**: 37. 1921.
[5] Rhodora **41**: 566–568. 1939.
[6] Enum. Pl. Transsyl. 492. 1866.

and those of sporadic occurrence as forms. The glabrous *Ranunculus abortivus* is predominently southern, the pilose var. *acrolasius* is northern.[7] Typical *Sphenopholis obtusata*, with leaves glabrous or scabrous, is irregularly dispersed over the eastern half of the United States, but is largely replaced by the pilose-leaved var. *pubescens* on the Coastal Plain and outer Piedmont.[8] On the other hand, *Alnus rugosa* var. *typica*, with essentially glabrous leaves, ranges from Nova Scotia to Michigan, south to New England, Pennsylvania, and Indiana; forma *emersoniana*, with leaves permanently pilose-tomentulose on the lower surface, is "of essentially the same range but forming individual and constant large colonies."[9] *Veronica connata* and its var. *glaberrima* seem much more comparable to the examples cited as varieties than to that treated as a form.

Conclusion: the name *Veronica connata* Raf. is probably valid for the species described by Pennell as *V. catenata* and treated by Fernald as *V. salina* Schur; the eastern glandular phase and the western glabrous phase are better treated as geographic varieties than as forms.

[7] Fernald, Rhodora **40**: 417–420. 1938.
[8] Fernald, Rhodora **43**: 533. 1941.
[9] Fernald, Rhodora **47**: 345–350. 1945.

ENTOMOLOGY.—*Revision of the genus* Nysius *in the United States and Canada (Hemiptera Heteroptera: Lygaeidae).*[1] H. G. Barber, Roselle, N. J. (Communicated by P. W. Oman.)

The genus *Nysius*[2] was described by Dallas in 1852 with 11 included species. Since that time several of these species have been transferred to other genera, but so many have been added that it has become a very large aggregation. Because of their general similarity and the wide dispersal of certain species considerable synonymy has resulted in the literature.

Stål, 1874, Horvath, 1890, Baker, 1906, and Usinger, 1942, have published complete or partial revisions of the genus; however, only that of Baker is restricted to the western world. Horvath's synopsis indicated some important characters, in addition to those mentioned by Stål for distinguishing the Palearctic species. In consequence, while the European species have been clearly recognized, some confusion has existed with reference to the application of certain specific names for forms occurring in the United States.

Both Uhler and Baker contributed to this confusion by failure to recognize the true identity of several previously described species. Whatever may have been his earlier views Uhler, in his *Check list of Hemiptera Heteroptera of North America*, 1886, apparently expressed his latest ideas in regard to the valid specific names. He erroneously cited *ericae* Schilling as a synonym of *thymi* Wolff and listed both *raphanus* Howard and *destructor* Riley as synonyms of his *angustatus*. In his *Observations upon heteropterous Hemiptera of Lower California*, 1894, he redescribed William Howard's *raphanus* as *strigosus* and a year later in the *Preliminary list of the Hemiptera of Colorado*, 1895, he again described the same species as *minutus*. The synonymy of this species should be stated as follows: *N. raphanus* Howard, 1862 = *destructor* Riley, 1863 = *strigosus* Uhler, 1894 = *minutus* Uhler, 1895.

Baker, in his *Notes on the Nysius and Ortholomus of America*, 1906, made several glaring errors through failure to recognize the identity of the Uhler species and through omission of any mention of either *raphanus* or *ericae*. His *angustatus* is evidently a mixed species, containing both Uhler's true *angustatus* and *ericae*. Having failed to recognize Uhler's species he redescribed it as *coloradensis*. Also mistaking the nature of Uhler's *strigosus* he synony-

[1] Received May 6, 1947.
[2] It has been demonstrated by W. E. China, *The generic names of British insects*, p. 243, 1943, and also by R. L. Usinger and R. I. Sailer, Proc. Ent. Soc. Washington **46**: 260, 1944, that this generic name will have to be changed unless conserved by action of the International Commission on Zoological Nomenclature.

mized it with the European *senecionis* (Schilling). The *strigosus* of Baker, not being the species Uhler described from Lower California, must be given a new name.

Baker described a number of varieties, two of which can be validated either as distinct species or subspecies: *coloradensis grandis* seems to be specifically distinct; *californicus alabamensis* is a good geographical race or subspecies, as it is confined to a definite area in the Eastern States. However, *californicus* var. *providus* (not Uhler) is *basalis* Dallas (*inaequalis* Uhler), and *angustatus* var. *niger* is merely a dark form of *ericae* scarcely worthy of subspecific status.

The foregoing conclusions in regard to synonymy in the genus are arrived at not only from study of the authors' written descriptions but are confirmed by authentically labeled specimens in both the Uhler and Baker collections now in the United States National Museum. A single male specimen from "Col.," labeled *Nysius angustatus* by Uhler, and another from "N. R. R." (Northern Railroad), were probably from the series which the author had before him when he drew up the original description written in 1872. Three carded specimens, a male and two females, are labeled "mistaken for the chinch bug, W. R. Howard," and although the specific name is not added there is no doubt that these represent his *raphanus*. Four carded specimens from "MO." bear the label "Type," written by C. V. Riley; although the name label has become detached there can be little doubt that this is his *destructor*. Riley admits, in his Fifth Missouri Report of 1875, that this is the same species described earlier by Wm. Howard as *raphanus*, who upon request agreed to suppress his name in favor of that of Riley's. A specimen from "Cheyenne, June '69," and another "Colo." both from the Baker collection and labeled *N. minutus* in Uhler's well-known writing, prove to be the same as *raphanus*. Dr. R. L. Usinger some time ago informed me that the type (No. 543) of *strigosus* Uhler, 1894, from Lower California, contained in the collection of the California Academy of Sciences, is the same species which Uhler later described as *minutus*. He kindly sent the cotype for confirmation. Other cotypes from the same series in the Uhler collection likewise confirm this synonymy. Thus, if it is conceded that *minutus* and *strigosus* are the same species and both synonymous with *raphanus*, it leaves *strigosus* of Baker, Horvath, Van Duzee, and others without a name. It should be mentioned here that some changes in synonymy are necessary in the Van Duzee Catalogue in order to conform to the foregoing opinions.

Another specific name of Uhler's will have to be placed in synonymy, as W. E. China, of the British Museum, has informed me by letter that *inaequalis* Uhler, 1894, from Grenada, West Indies, is the same as *basalis* Dallas, 1852, from Jamaica.

R. L. Usinger, who has examined the collection of *Nysius* deposited by Baker at Pomona College and has sent to me his notes on it, informs me that Baker attached red labels to certain specimens of his species, as follows: *californicus alabamensis*, *coloradensis*, and *grandis*. It was evidently his intention to consider these particular specimens as types of his species, but unfortunately this information remained unpublished and the specimens have no more than cotype value. It seems fitting to select these red-labeled specimens as lectotypes, as it was at Pomona College that Baker carried on his investigations in preparation for his *Notes on the Nysius and Ortholomus of America*. Many cotypes were also deposited in the United States National Museum which are noted later in the body of this article.

The writer received much information concerning the more important characters to be used in differentiating the species of *Nysius* from the very excellent treatment of the genus by R. L. Usinger, *The genus Nysius and its allies in the Hawaiian Islands* (Bernice P. Bishop Mus. Bull. 173, 167 pp., 1942).

Certain of the species are so closely related that use must frequently be made of relative rather than positive characters. Relative dimensions of body parts are utilized to a considerable extent. All such measurements were made with the small Zeiss binocular microscope, using the No. 4 ocular and Aa objective. Body propor-

tions are expressed in units equal to 0.0222 mm each.

Both in the discussion of the respective species and in the key only male specimens are referred to.

Thanks are due to Drs. E. A. Chapin and R. I. Sailer for the loan of many specimens from the U. S. National Museum collection, and again to the latter for much detailed information concerning the fixation of types for certain species; to W. E. China, of the British Museum, for comparison of specimens and for valuable information; and to Dr. R. L. Usinger, of the University of California, for reviewing this manuscript and for many helpful suggestions which have added to its value. The writer is indebted to Dr. G. Stuart Walley, Dominion Agricultural Department, Ottawa; to George A. Moore, of Montreal; and to J. F. Brimley, of Wellington, Ontario, for sending many specimens from various parts of Canada.

Nysius californicus Stål

Nysius californicus Stål, 1860, Freg. Eugenies Resa, p. 242; 1874, Enum. Hem. **4**, p. 120.—Baker, 1906, Invert. Pacif. **1**, pp. 134, 135.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 158.—Usinger, 1941, Brooklyn Ent. Soc. Bull. 36, p. 131.

Nysius major Berg, 1878, Anal. Soc. Cient. Argentina, p. 225; 1879, Hem. Argen., p. 101. (New synonymy.)

Nysius californicus is the largest species of the genus occurring in the United States, 5.50–7 mm long, reaching its maximum size in California and decreasing in size in its more easterly range through Texas, Kansas, Nebraska, and Missouri. It may be distinguished from all the other species except *basalis* by the much shorter bucculae which scarcely extend behind middle of the gular region of head. The costal margin of corium is distinctly contracted for a short distance at base, not more than a third the length of scutellum, thence very nearly straight to apex of corium. Length of head is very nearly equal to that of the pronotum. Lengths of the antennal segments are as follows: 0.4050, 0.7875, 0.6750, and 0.7875 mm, respectively. Genital segment of male is black, broadly margined with pale yellow.

Distribution: Western Canada and the entire western United States, Mexico, Central America, and South America south to Argentina.

Nysius californicus alabamensis Baker

Nysius californicus alabamensis Baker, 1906, Invert. Pacif. **1**, pp. 135, 137.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 158.

This evidently should be maintained as a subspecies occupying a rather definite region in the eastern United States. Having an average body length of 4.75 mm (male), it averages smaller than the typical subspecies and also shows a somewhat darker shade of cinereous.

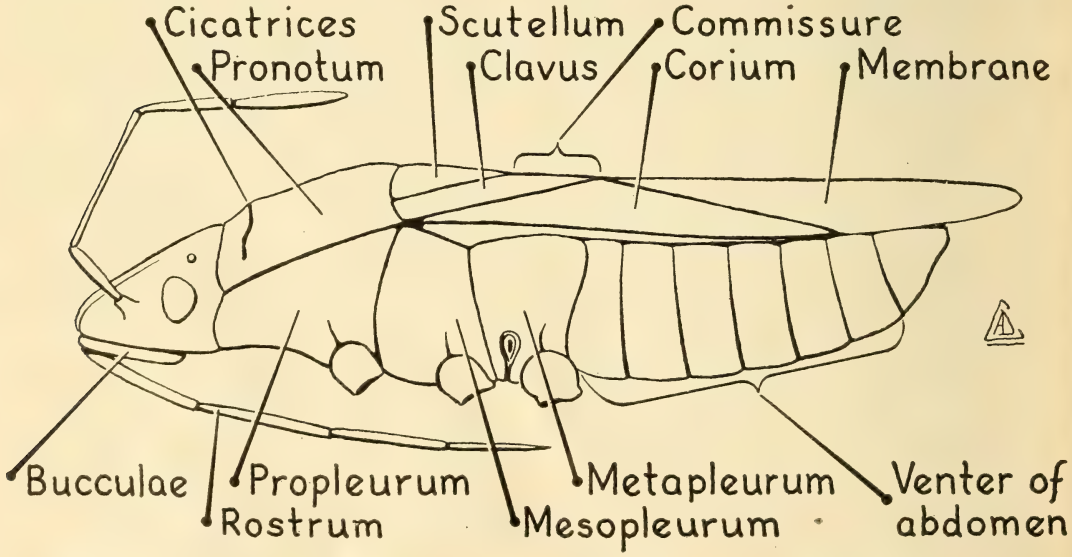


FIG. 1.—Diagrammatic lateral view showing essential parts used in descriptions.

The antennae are considerably shorter; the respective lengths of the segments are as follows: 0.315, 0.5625, 0.5175, and 0.675 mm.

Lectotype female: Auburn, Ala., VII-10-96 (C. F. Baker No. 2298), in the collection at Pomona College. Cotypes: Auburn, Ala., V-5-97 (C. F. Baker No. 2267), and Opelousas, La., IV-97 (C. F. Baker No. 2265), in the United States National Museum.

Distribution: From Ontario, Canada, on the north, through the New England States and eastern half of the United States to Florida and the Gulf States.

Dr. Harold Morrison collected this form in the Dominican Republic in 1917, and Dr. S. C. Bruner has a single specimen collected by J. Acuña in the province of Oriente, Cuba.

Nysius basalis Dallas

Nysius basalis Dallas, 1852, List Hem. Brit. Mus. **1**, p. 553.—Barber, 1923, Amer. Mus. Nov. 75, p. 12.—Blatchley, 1926, Heter. East. N. Amer., pp. 351, 352.
Nysius (?) *ementitus* Distant, 1893, Biol. Centr.-Amer., Rhynch., **1**, Suppl., p. 385, tab. 34, fig. 9.
Nysius inaequalis Uhler, 1894, Proc. Zool. Soc. London, p. 183.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 158 (exclude Baker).—Barber, 1939, Sci. Surv. Porto Rico **14**, pp. 340, 341.
Nysius californicus providus, Baker[3] (not Uhler), 1906, Invert. Pacif. **1**, p. 137.

Nysius basalis is about the size of *alabamensis* Baker. The color yellow-testaceous rather than cinereous, with the fuscous markings less evident, often more or less effaced. It agrees with *californicus* in having short bucculae, but the costal margin of the corium is scarcely if at all contracted at base and the entire outer costal margin is gently arcuate rather than straight. Posterior disk of the pronotum with a distinct, short, smooth, longitudinal callosity on either side of middle. Pronotal cicatrices are either concolorous or frequently reduced to four short fuscous marks. Most frequently in the darker forms a narrow, smooth, pale line extends from the middle of the vertex of head through the middle of the pronotum and scutellum. Veins of the corium sometimes only faintly spotted. The membrane is clear, transparent, occasionally with a faint, fuscous, apical streak. Genital segment of the male is either entirely pale yellow or sometimes with a slight fuscous area at base. Antennae are either entirely pale or the basal and terminal segments, as well as the bases of the second and third, lightly infuscated. Length, male, 4.70 mm.

Distribution: Dallas described this species from Jamaica and Brazil. Uhler described the same species as *inaequalis* from Grenada, West Indies, nine cotypes of which are in the collection of the United States National Museum; the type series is in the British Museum. Other specimens have been examined from the following localities: Jamaica, Dominican Republic, Haiti, Puerto Rico, St. Thomas, Cuba, Antigua, Guadeloupe, all in the West Indies; Mexico, Costa Rica, Honduras, Guatemala, Colombia, Trinidad, and northern Brazil. In the United States this species, from the evidence at hand, is restricted to Florida and the Gulf States.

W. E. China, of the British Museum, has kindly sent me a paratype of Distant's *ementitus* from Guatemala, labeled B. C. A., Cerro Zunil, 4000–5000 feet (Champion). A comparison of this with a cotype of *inaequalis* from Grenada shows that the names are synonymous.

In addition to the synonymy indicated above there is the possibility that *N. callifer* Stål from Colombia may have to be added to the list.

Nysius adjunctor, n. sp.

Color darkened cinereous, marked with fuscous as follows: Head broadly on either side of a narrow, pale, longitudinal, median fascia, cicatrices and punctures of the pronotum, scutellum, except the extreme apex, apices of the clavi, rather obscure maculae on the veins and along the posterior margin of the corium, spots on the femora and the bases of the tibiae.

Head nearly one-fifth wider than long (42:34); bucculae short, scarcely exceeding anterior margins of eyes. Antennae 1.86 mm long; second segment nearly one-third longer than basal, second and fourth subequal, each a fifth longer than third segment. Pronotum about one-third wider than long; cicatrices wide, conspicuous, connected in the middle; dorsum coarsely punctate. Scutellum nearly one-fourth wider than long (32:25), coarsely punctate at base and along the sides. Corium coated with fine, inclined hairs; basal costal

[3] In my copy of Baker's reprint the author has written, "The specific names *providus* and *inaequalis* should be interchanged wherever they occur."

margin not noticeably contracted but densely pilose; the outer margin gently rounded from base to apex. Membrane well extended beyond apex of the abdomen, hyaline, faintly smudged with fuscous along the middle; that portion which is beyond the apices of the coria is distinctly longer than the basal portion. Length, male 4, female 5 mm.

Type male: Chisos Mountains, Texas, VII-17-46 (collected by D. J. and J. N. Knull). Paratype female: Same data as type. Both in the collection of the Department of Zoology and Entomology, Ohio State University. Paratypes male and female: Guadalajara, Jalisco, Mexico, September 1903 (writer's collection).

This species with the short bucculae is rather closely related to *basalis*. I have been informed by Mr. China, of the British Museum, that W. L. Distant had this particular species mixed with his series of *ementitus* which I have made a synonym of *basalis*. Besides a difference in coloration it is somewhat smaller and narrower than *basalis*, with little evidence of longitudinal callouses on the disk of the pronotum.

Nysius angustatus Uhler

Nysius angustatus Uhler, 1872, 5th Ann. Rep. Geol. Surv. Terr. for 1871 (Hayden's Survey), p. 406; 1886, Check List Hem. Het., p. 13 (exclude synonyms).

Nysius coloradensis Baker, 1906, Invert. Pacif. **1**, p. 136.

Nysius ericae Van Duzee, 1917, Cat. Hem. N. Amer., p. 159 (part).—Blatchley, 1926, Heter. East. N. Amer., p. 353 (part).

Color cinereous, marked with fuscous much as in *ericae*. The following parts more or less strongly marked with fuscous: Ocellar region of the head, pronotal cicatrices, scutellum along the middle region, spots on veins of the corium and also two conspicuous fascia on the posterior margin. Genital segment of male black narrowly margined with pale yellow. Membrane clear with ill-defined faint markings on the disk. Antennae testaceous, with the basal and apices of the second and terminal segments darker.

Head about one-fourth wider than long (45:32), lightly convex transversely. Antennae 2.03 mm long; basal segment somewhat incrassate, extended beyond apex of head by about one-fourth of its length; second segment about twice as long as basal; third segment one-fourth shorter than second and terminal subequal to second. Bucculae strongly elevated, gradually narrowing to end abruptly at base of head. Basal segment of rostrum not quite attaining apices of the bucculae. Pronotum about as long as the head (32:32), much wider than long (45:32); lateral margins lightly concave; cicatrices sharply defined, narrowly black. Scutellum about one-fifth wider than long (28:20). Costal margin of corium contracted at base for a distance equal to about two-thirds the length of the scutellum thence distinctly expanded and gently rounded to apex. Length, male, 4.25–4.50 mm.

Lectotype male: "Col.," labeled *Nysius angustatus* by Uhler. Cotype: "N. R. R." (Northern Railroad). Both from the Uhler collection in the United States National Museum.

Distribution: Across entire Dominion of Canada from Quebec to British Colombia; northern United States from Maine to Oregon and Washington. Not yet seen from California, but it should occur in the northern part of that state. Its southern limits seem to be in northern Kansas.

Lectotype of *coloradensis* Baker, female: Foothills, 5 miles west of Fort Collins, Colo., VIII-4-95 (C. F. Baker No. 1593), in the Baker collection at Pomona College.

Cotypes, males and females: Foothills west of Fort Collins, Colo., VIII-11-96 (no. 887); Steamboat Springs, Colo. VII (1329); foothills west of Fort Collins, Colo., VII (1370, 1371) and VII-10-96 (2325); Fort Collins, Colo., V-16-95 (1524); VI-13-95 (1563); VIII-20-95 (1604); VIII-8-96 (2632); VIII-27-96 (2084); VI-16-96 (2170); Camptons, Colo., VII-21-95 (1580); Morris Ranch, Laramie County, Colo., VII-11-96 (2009); mouth of Big South, Laramie County, Colo., VII-12-96 (2011); Grizzly Creek, Laramie County, Colo., VII-19-96 (2012); Forresters, Laramie County, Colo., VIII-3-96 (2013, 2020); Rabbit Ears Pass, VII-2-96 (2019); Spicers, North Park, Colo., VII-18-96 (2024); Chambers Lake, Colo., VIII-1-96 (2033) and VII-13-96 (2253); Cameron Pass, Colo., VII-31-96 (2037) and VII-30-96 (2150); Hardys Ranch, North Park, Colo., I-29-96 (2061); Elkhart, Ind., VIII-29-96 (2087); Toronto, Canada, IX-30-96 (2038) and V-25-96 (2142). All cotypes in the collection of the United States National Museum.

Two of Baker's cotypes of *coloradensis* are from Toronto, Canada, showing that he recog-

nized these as the same as his Colorado form, from whence most of his material came. The writer has received many specimens of *angustatus* Uhler (= *coloradensis* Baker) from Quebec, Ontario, Saskatchewan, Manitoba, Alberta, and British Columbia in Canada. It has often been confused with both *ericae* and *thymi*.

Nysius grandis Baker

Nysius coloradensis grandis Baker, 1906, Invert. Pacif. **1**, p. 136.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 160.

Although closely related to *angustatus* differences in coloration as well as in relative size and shape of parts indicate that *grandis* should be given specific rank. In this species the differences are for the most part relative rather than positive.

Color darker than *angustatus*, often rusty fuliginous, the fuscous markings more conspicuous. Other noticeable differences are: Fuscous cicatrices of the pronotum are broader, more conspicuous and less sharply defined; pronotum posteriorly more coarsely punctate; scutellum black, devoid of a pale area on either side of the middle; veins of corium and the posterior margin more heavily splotched with fuscous; membrane less clear, faintly tinged with brown and the fuscous spots more evident; femora more profusely spotted.

Compared to *angustatus* the head is wider (50:35), the vertex flatter, the eyes appearing a little larger; the bucculae are similar, but the basal segment of the rostrum usually extends to the apices of the bucculae; the antennae are definitely longer; the pronotum is flatter and not so noticeably depressed anteriorly, also appearing more quadrate (38:38:60); the costal margin is a little more flaring posteriorly. Length, male, 4.80–5.00 mm.

Lectotype male: Rabbit Ears Pass, Colo., VIII-4-95 (Baker No. 2019), in the Baker collection at Pomona College. Cotypes, males and females: Chambers Lake, Colo., VII-18-95 (No. 1582) and VIII-1-96 (2033); Fort Collins, Colo. (1733); Morris Ranch, Laramie County, Colo., VII-11-96 (2009); mouth of Big South, Laramie County, Colo., VII-12-96 (2011); Rabbit Ears Pass, Colo., VII-21-96 (2019) and VII-20-96 (2270); Four Mile Hill near Steamboat Springs, Colo., VII-21-96 (2030); 5 miles west Cameron Pass., Colo., VII-29-96 (2041). All cotypes are in the Baker collection at the United States National Museum.

Distribution: Because of lack of sufficient evidence the exact limits of the range are uncertain. So far as the writer's records go this species is confined to the higher altitudes with an extended range from Churchill, Manitoba, on the north to Arizona in the United States and through Mexico to Panama. A single female specimen from the Biologia Centrali-Americana material in the United States National Museum is labeled Volcán de Chiriquí (Panama), 4,000 to 6,000 feet.

Nysius thymi (Wolff)

Lygaeus thymi Wolff, 1804, Icon. Cim. **4**, p. 149, tab. 15, fig. 142; 1804, Abblg. Wanz. **4**, p. 147, tab. 15, fig. 143.

Nysius thymi Horvath, 1890, Rev. d'Ent. **9**: p. 188.—Van Duzee, 1917, Cat. Hem. N. Amer. (part).

Nysius angustatus, *grandis*, and *thymi* constitute a group of closely related species resembling each other superficially and not always easy to separate through reference to structure alone. As expressed elsewhere distinctions are often more relative than positive.

In general, *thymi* will average smaller than *angustatus* and is darker, being more rusty cinereous in color. The preocular part of the head is only slightly longer than an eye (16:14), while in *angustatus* this is about 17:13; the antennae are equal in length to those of *angustatus* but definitely shorter than in *grandis;* the bucculae are distinctive, being rather high anteriorly and narrowing posteriorly to end a little before base of head, not at base as in *angustatus*. Scutellum, except at extreme apex, black. Although somewhat variable the contracted basal part of the costal margin is usually a little longer in relation to the length of scutellum. Membrane faintly infumed with brown, splotched along the middle with fuscous. Length 3.60–4.00 mm.

Distribution: As a very limited number of specimens of this species have been seen by the author, the delimitation of its range in North America will have to wait for more evidence. Specimens are at hand from Wanakena, Cranberry Lake (C. J. Drake), and from near Sabael, Indian Lake, in the Adirondack Mountains, Keene Valley in Essex County, and Mountain View in Franklin County, all in New York State. Through Dr. G. Stuart Walley, of Ottawa, specimens have been received from Thunder River and Natashquan in Quebec, Canada, near the mouth of the St.

Lawrence River. Anse au Griffon, Quebec (J. M. Aldrich).

N. thymi is a Palearctic species occurring across northern Europe and Siberia. From the evidence at hand it reached the North American continent by way of the northeast rather than the northwest from Siberia.

Nysius ericae (Schilling)

Heterogaster ericae Schilling, 1829, Beitr. Ent. **1**, p. 86, pl. 7, fig. 10.
Nysius thymi, Uhler, 1886, Check List Hem. Het., p. 13 (part).
Nysius ericae, Horvath, 1890, Rev. d'Ent. **9**, p. 186.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 159 (part).—Blatchley, 1926, Heter. East. N. Amer., pp. 351, 353, fig. 14 (excl. syns.).
Nysius angustatus, Baker (not Uhler), 1906, Invert. Pacif. **1**, p. 135 (part).
Nysius angustatus niger Baker, 1906, Invert. Pacif. **1**, pp. 135, 136. (New synonymy.)

Color cinereous. Punctations and fuscous markings similar to *angustatus*, the punctures on the pronotum often arranged in five irregular, longitudinal series; scutellum except extreme apex, black, occasionally with a vague, pale spot on either side of middle; corium having fine, appressed pubescence, nearly devoid of erect hairs; veins very lightly spotted; membrane clear, very faintly if at all spotted. Genital segment of the male entirely black or more rarely with a very narrow pale margin.

Head about one-third wider than long (42:26); eyes less projecting than in *angustatus*. Antenna with the short basal segment scarcely exceeding apex of head; second segment about twice as long as basal, third a little shorter than second and the terminal either subequal to or a little longer than the third segment (12:25:20:25). Bucculae less elevated than in *angustatus*, gradually narrowing in height to terminate at a point before base of head. Pronotum nearly one-third wider than long (50:30), subequal to or a little longer than head; across posterior margin one-fifth wider than head across eyes. Scutellum much wider than long (33:23). Corium rather opaque. Costal margin contracted at base for a distance equal to two-thirds the length of scutellum, thence very little expanded and gently rounded to apex. Costal margin at base sparsely pilose; the general surface usually devoid of erect hairs. Membrane only slightly surpassing apex of abdomen in the male, more extended in the female, but less so in both sexes than in *raphanus*. Basal part of membrane between commissure and apices of coria subequal to the apical part behind apices of coria.

Distribution: *N. ericae* is a Holarctic species with a very wide range in Europe, northern Africa and parts at least of central Asia. In North America it occurs in the entire Dominion of Canada from New Brunswick to British Columbia and in the United States across all the northern States from Maine to Washington, Oregon, and northern California. In the region of Kansas it overlaps the range of *raphanus* which replaces the above species through the southern states.

As stated above in the synonymy of the species it has been much confused with *angustatus*. It differs from *angustatus*, besides being smaller, in having less elevated bucculae which do not terminate so abruptly but taper off to end at a point before base of head. It is more closely related to *raphanus;* however, the latter has a shorter pronotum and longer hemelytra, with the membrane more extended beyond the end of the abdomen. Length, male, 3.25–3.70 mm.

It should be recorded here that the lectotype of *angustatus niger* Baker, a synonym of *ericae*, is a female labeled "Wash. No. 2508" in the Baker collection at Pomona College. Four cotype females, with the same data, are in the Baker collection in the United States National Museum.

Nysius raphanus Howard

Nysius raphanus Howard, 1872, Southern Farmer **6**, p. 273; 1872, Can. Ent. **4**, p. 219.
Nysius destructor Riley, 1873, 5th Rep. Insects Missouri, p. 113.
Nysius strigosus Ubler, 1894, Proc. California Acad. Sci. (2) **4**, p. 238. (New synonymy.)
Nysius minutus Uhler, 1895, Hem. Colorado, p. 22.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 160. (New synonymy.)
Nysius angustatus minutus, Baker, 1906, Invert. Pacif. **1**, p. 137 (listed).
Nysius ericae, Milliken (not Schilling), 1918, Journ. Agr. Res. **13**, pp. 571–578, pls. 60, 61.

Coloration and facies resemble *ericae* very closely. Head is about one-third wider than long (30:20). The antennae are shorter than in *ericae*, basal segment barely exceeds apex of head, lengths of the segments are 10:22:18:26. Bucculae lightly elevated, gradually narrowing posteriorly to end in a point before base of head, much as in *ericae* but not so abruptly terminating as in *angustatus*. Pronotum is

noticeably short, often nearly twice as wide as long, in the male (45:23), little longer than head. Scutellum, except at extreme apex, is usually black, much wider than long (23:15). Costal margins of coria are very nearly straight in the male and parallel to each other, less expanded, even in the female, than in *ericae*. Membrane clear, appearing longer than in *ericae* as it extends farther beyond the tip of the abdomen. The apical part of the membrane is distinctly longer from the apices of the coria than the basal part of membrane before these. Genital segment of male usually entirely black. Smaller than *ericae*, 3.10–4.00 long.

Lectotype male: From Wm. Howard's set of three (carded), labeled "mistaken for the chinch bug." United States National Museum.

Lectotype *destructor* Riley: Male from C. V. Riley's set of four (carded), labeled "Type," United States National Museum.

Lectotype *minutus* Uhler: Male, "Colo. No. 1684," labeled *Nysius minutus* by Uhler, United States National Museum.

Type and cotypes of *strigosus* Uhler are in the collection of the California Academy of Sciences. Cotypes in the United States National Museum.

Distribution: Throughout all the southern states from Virginia south to Florida, and west across the United States to southern California, with some extension into Mexico. In its northern limits it overlaps the more northern *ericae*.

Through a misidentification Uhler labeled a specimen from Cheyenne, Wyo., June 1869, as *angustatus* Uhler. This specimen was erroneously selected as the type of that species under catalogue No. 693 in the United States National Museum. Since no Wyoming locality is mentioned in the original description it is clear that the specimen is not part of the cotype series of *angustatus*.

Nysius monticola Distant

Nysius (?) *monticola* Distant, 1893, Biol. Centr.-Amer., Rhynch. **1**, Suppl., p. 385, tab. 36, fig. 8.

Color dark cinereous, with ground color of head and pronotum brownish red, heavily marked with fuscous on either side of head, and anteriorly on the pronotum. Corium opaque, the surface having a dense coating of short, appressed silvery hairs, interspersed with some scattered longer, erect hairs, the costal margin of corium appearing clearer in contrast; veins much spotted with fuscous. Scutellum, except at extreme apex, black. Ventral segments of abdomen of male as well as the genital segment, black, with slight indications of testaceous maculations. Membrane spotted with fuscous.

Head one-fourth wider than long. Pronotum two-fifths wider than long and subequal to length of the head. Scutellum one-third wider than long. Antennae with second segment twice as long as basal, second and fourth segments subequal. Contracted basal part of corium equal to length of the scutellum. Basal part of membrane from apex of commissure to apices of coria is but little shorter than the apical part of membrane behind these apices. Length, male, 3.80 mm.

More closely related to *ericae* than to other species of *Nysius* but is much darker and more pubescent than that species.

A specimen from Bright Angel Camp, Ariz., elevation 6,900 feet, collected by Wickham, was sent to W. E. China, of the British Museum, for comparison with the type. He writes that while this specimen strongly resembles Distant's type the relation of the width of the head to its length does not agree. I have since made measurements of a number of Mexican and Arizona specimens and find that the range of variability in this respect is considerable.

Distribution: Guatemala (Distant): Temescaltepec and Cuajimalpa, Mexico (R. L. Usinger); Chiricahua Mountains, Peach Springs, and Springerville, Ariz.; Beulah, N. Mex.; Brewster County, Tex., in the collection of the California Academy of Sciences; Huachuca Mountains, Ariz.; Palmer Lake and Trinidad, Colo. (writer's collection); specimens from Arizona and Colorado in the collection of the United States National Museum.

Nysius tenellus, n. sp.

Nysius senecionis, Baker, 1906, Invert. Pacif. **1**, pp. 135, 136, 137 (not Schilling).

Nysius strigosus, Horvath (not Uhler), 1908, Ann. Mus. Nat. Hungarici **6**, p. 558.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 160.—Barber, 1939, Sci. Surv. Porto Rico **6**, pp. 340, 342.

Typical pale form: Color pale yellow testaceous; punctations for the most part concolorous. The following parts fuscous: Head on each side with an abbreviated fascia extending anteriorly from base of head to a short distance before the ocelli, cicatrices of pronotum, depressed base of the scutellum, four rather inconspicuous spots on the posterior margin of

corium; ventrally with an irregular spot on both the pro- and mesopleura, the meso- and metasternum, and the basal half of the venter. Legs vaguely, if at all, spotted.

Head much wider than long (35:25); eyes less projecting than in *ericae*. Bucculae rather strongly elevated throughout, the lower edges very nearly straight, ending abruptly at base of head. Antennae about as long as head, pronotum, and scutellum united, basal segment short, scarcely surpassing apex of head; second segment twice as long as basal, third somewhat shorter than second and terminal subequal to the second segment (10:23:20:23). Pronotum finely, closely punctate, nearly one-third wider than long (46:30), a little longer than the head and about one-third wider across humeri than head across eyes (46:35), seen from the side distinctly depressed in the region of the cicatrices which are narrow and disconnected in the middle. Scutellum nearly one-third wider than long (28:20), apical carina distinctly elevated. Corium hyaline, glabrous; veins plainly elevated and immaculate; costal margins contracted at base and parallel to each other for a distance equal to the length of the scutellum thence slightly flaring and gently rounding to apices; contracted part devoid of fine pile or hairs. Membrane hyaline, immaculate. The basal part of the membrane from the apex of the commissure to apices of the coria is distinctly shorter than the apical part beyond the apices of coria. Length 3.60–4.00 mm.

Atypical dark form: In some parts of the range of the typical form there occurs a darker variety, possibly a seasonal form, in which the punctations and fuscous markings are very much more pronounced, causing it to resemble *ericae* very closely in general appearance. However this variety can very readily be distinguished from *ericae* by the same structural differences as shown in the typical form. Specimens of this dark variety have been seen from California, Washington, and Utah.

Distribution: In western North America it ranges from British Columbia south through all of the Rocky Mountain States and west to California. In the southern United States it occurs in western Texas, Arizona, New Mexico, and Florida, and south through Mexico and Central America. In the West Indies it is found at least in Haiti and Puerto Rico.

Type male and allotype: Santa Clara County, Calif., Baker (U. S. Nat. Mus.).

Paratypes, males and females: Arizona: 1, Chiricahua Mountains, VIII-10-07 (Webb); 1, Stone Cabin Canyon, Santa Rita Mountains, VIII-25-13 (Pierce), on pink *Sphaeralcea;* 9, Tucson, VIII-11-14 (Coad), on peach; 5, Tucson, V-6 (Hubbard); 5, Tucson, XII-20 (Hubbard); 37, Sabino Canyon, IV-23-40 (Oman); 5, Patagonia, VIII-23-37 (Andre); 20, Chiricahua Mountains, VI-9-33 (Oman); 3, Yarnell Heights, VI-29-33 (Oman); 4, Phoenix, V-27-38 (Christenson); 2, Mesa, IX-10-38 (Christenson); 1, Glendale, VIII-5-38 (Christenson); 1, Nogales, Santa Cruz County, IX-20-06 (Nunenmacher); 1, Tucson, 6-16-33 (Oman); 2, Tucson, V-27-1896 (Kunze); 4, Tucson, 4-30-1896 (Kunze); 9, Prescott, V-15-1896 (Kunze); 2, Tucson, V-27-1896 (Kunze); 1, Tucson, V-20-1896 (Kunze); 3, Arizona (Uhler collection); 8, Monte Vista, altitude 9,000 ft., Chiricahua Mountains, VII-10-19 (Whetmore); 6, Sasabe, X-17-37 (Oman); 10 Mount Lemmon, VIII-23-37 (Andre); 3, Williams, VIII-13-37 (Andre); 11, Oak Creek Canyon, VIII-6-38 (Christenson); 1, Flagstaff, V-31-35 (Oman); 2, Granite Dells, V-30-37 (Oman); 9, Yarnell Heights, V-31-35 (Oman); 1, Oak Creek Canyon, IV-8-40 (Christenson); 3, Congress Jct., VI-28-33 (Oman); 1, Tucson, VI-18-33 (Oman); 1, Fort Huachuca, VI-10-33 (Oman); 1, Tubac, VI-24-33 (Oman); 2, Tucson (Webb); 1, Santa Rita Mountains, IV-25-40 (Oman; 1, Santa Cruz River near Tubac, X-23-37 (Oman); 3, Williams, VII-24-05 (Barber & Schwarz); 1, Williams, V-27-05 (Barber & Schwarz); 1, Williams, VII-1-05 (Barber & Schwarz); 1, Williams, VI-3-05 (Barber & Schwarz); 1, Bright Angel, Colorado Canyon, V-5-05 (Barber); 1, Palo Verde, VI-11-19 (Whetmore); 1, Littlefield, II-15-32, *Chrysothamnus speciosus* (Davis); 1, Williams, VII-11-18 (Whetmore); 1, Mount Graham, V-3-14 (Holt).

Mexico: 1, Mexico City, VI-21-1897 (Barrett); 1, Juárez, VII-3-1897 (Morse); 1, Sacramento, X-1896; 2, Mexico, intercepted at Brownsville, IV-22-36, on Shasta daisies; 2, Mexico, intercepted at Brownsville, IV-24-36, in lilies; 2 Mexico, intercepted at Brownsville, X-29-36, on chrysanthemums; 2, Mexico, intercepted at Brownsville, V-8-37, on Shasta daisy; 1, Mexico, intercepted at Brownsville, V-1-36, in lilies; 2, Mexico, intercepted at Laredo, Tex., II-18-34, on feverfew; 1, Mexico, intercepted at Brownsville, X-30-38, chrysan-

themums; 1, Mexico, intercepted at El Paso, Tex., XI-12-40, med. herbs; 2, Mexico, intercepted at El Paso, Tex., X-31-40, chrysanthemums; 2, Mexico, intercepted at Brownsville, III-25-40, Manzanilla; 1, Nogales, Sonora, intercepted at Nogales, Ariz., VI-5-41, cut flowers; 1, Nogales, Sonora, intercepted at Nogales, Ariz., VI-21-41, cut flowers; 1, Victoria, III-16-22 (Holloway & T. C. Barber); 2, Cuernavaca, Mor., II-1945 (Krauss), on flowers of *Eupatorium adenophorum;* Tamasopa, 1, VII-4-09 (Bishopp); 1, San José de Guaymas, IV-10 (L. O. Howard).

Honduras: 1, La Ceiba, IX-11-16 (Dyer).

Haiti: 5, Haiti (W. A. Hoffman).

Puerto Rico: 2, Santurce, V-19-34, on *Pluchea purpurascens.*

All in the collection of the United States National Museum.

California: 11, Taylorville, VIII-11-37; 22, Pasadena, II-20-28; Palo Alto, IV-30-28 (H. G. Barber); Inyo Mountains, VII-7/11 (Wickham); San Diego County, IV-7-13 (Van Duzee); San Antonio Canyon, Ontario, VII-27-07; Santa Clara County, V-1902. Arizona: Huachuca Mountains, VII-8/15-05 (H. G. Barber); Sabino Canyon, Santa Catalina Mountains (Knight); Phoenix, IX-25-02, and Prescott, VII-15-1898 (Palm). In the collection of the writer.

All the following additional material is in the collection of the National Museum:

Utah: 1, Provo, X-22-38 (Christenson); 1, Logan Canyon, IV-21-41 (Knowlton & Nye); 1, Promontory, X-6-14 (Whetmore); 1, Provo, VIII-23-36 (Christenson); 1, Lehi, IX-1905 (Hooker); 1, Spanish Fork, VIII-21-38 (Hardy) 2, Moab, X-25-38 (Christenson); 1, American Fork Canyon, VI-23-1891; 2, Alta, 10,000 ft., VI-30-1891 (Uhler collection); 1, Willard, X-5 (Whetmore).

Colorado: 1, Steamboat Springs, July (Baker); 1, Elk River, July (Baker).

Washington: 1, Wenatchee Mountains, VII-9-30 (Rolfs); 1, Mount Rainier, VII-17-37 (Benmion); 1, Yakima (Uhler collection); 7, Orville, X-9-40 (Christenson); 5, East Wenatchee, X-5-46 (Christenson); 2, Cheney, X-1-32 (Rodock), *B. tectorum;* 5, Clarkston, XI-23-32 (Rodock), rabbit brush *Chrysothamnus;* 4, Pullman, VII-23-08 (Mann); 1, Hunts Junction, IX-13-04 (Titus); 2, Pasco, IX-11-04 (Titus).

Oregon: 1, north of Bend, VII-2 (Oman); 1, Corvallis, VIII-8-31; 1, Echo, VII-15-04 (Titus); 11, Hood River, IX-21-07 (Morse).

Idaho: 2, Twin Falls, VII-2-28, *Beta vulgaris;* 1, Blackfoot, VI-22-04 (Titus).

British Columbia: 1, Kaslo, VII-16 (Caudell); 1, Vancouver Island (Uhler collection).

Western Territories: 6 (Uhler collection).

California: 6, Santa Cruz Mountains; 1, California (Uhler collection); 4, Taylorville, Marin County, VIII-11-37 (H. G. Barber); 4, Los Angeles County, July; 15, Calipatria, X-28-21 (Kalmbach); 3, Mojave, XI-11-14 (Whetmore); 1, Tulare County, VI-6-09 (Davidson), *Helianthus;* 1, Cajon, VIII-9-37 (Harris); 2, Spreckels, IX-20-04 (Titus), sugar beets; 1, Ontario (Osborn); 2, Claremont (Baker); 1, Holtville (Wildmuth); 2, Hemet, VIII-15-39 (Christenson), *Erigeron canadensis;* 7, Three Rivers, VI-9-35 (Oman); 3, Fieldbrook, V-29-03 (H. S. Barber); 1, Los Angeles, April (S. O. Howard); 1, Cajon Pass, V-6-35 (Oman); 3, near Tehachapi, VI-8-35 (Oman); 2, east of Jacumba, VI-1-35 (Oman); 6, Sequoia National Forest, Hospital Rock, VI-11-35 (Oman); 4, Tehachapi, VIII-2-1897 (Morse); 5, Los Angeles, VII-29-1897 (Morse); 5, Los Angeles, VII-21-1897 (Morse); 2, San Bernardino, VII-18-1897 (Morse); 1, Yosemite Valley, VIII-10-1897 (Morse); 1, Berkeley, VIII-20-1897 (Morse); 1, Lancaster, VII-31-1897 (Morse); 1, Baden, VIII-24-1897 (Morse); 9, Santa Clara County (Baker); 5, Garden Grove, XII-28; 1, Laguna Mountains, San Diego County, VIII-21-19 (Pierce), *Artemisia tridentata;* 2, Tamalpais, 2,500 ft., XI-15-1899 (L. O. Howard); 9, Yucaipa, VI-7-38 (Christenson); 2, Echo Lake, VII-23-33 (Zimmermann); 7, Banning, II-14-39 (Christenson); 1, Mather, VII-4-32 (Zimmermann); 1, head of Virginia Canyon, Yosemite Park, 10,000 ft., VIII-5-39, ex *Poa leibergii* (Usinger); 2, Salinas, VIII-26-42, (Lange), *Parthenium argentatum* Gray; 1, Scotia, V-5 (H. S. Barber).

Nevada: 6, Ormsby County, July (Baker).

New Mexico: 10, Mesilla Park, V-25-09 (Ainslie); 2, Organ, VI-8-33 (Oman); 1, Las Cruces, VII-1903 (Cockerell), on alfalfa; 1, Cloudcroft, VI-7-33 (Oman).

Texas: 3, Bangs, X-17-39 (Christenson); 1, Brownsville, V-17-39, intercepted on feverfew; 1, Brewster County, Chisos Mountains, VI-10-08 (Mitchell & Cushman); 2, Brownsville, V-31-33 (Oman); 2, Sanderson, VI-5-33 (Oman); 2, Bexar County, XI-28-38 (Turner).

Nysius insoletus, n. sp.

Color pale yellow-testaceous with the following fuscous markings: A rather wide longitudinal fascia on each side of the head extending from the base to the apex of the antenniferous tubercles, a spot behind eyes, terminal segment of antenna, cicatrices of pronotum, lateral angles and median longitudinal fascia of the scutellum, very obscure spots on the veins and along the posterior margin of the corium; beneath, with the head vaguely on each side of the bucculae, a large median spot on the propleurum and a narrow longitudinal line above this, center of the mesopleurum, a narrow longitudinal line above the evaporating surface of the metapleurum and the meso- and metasternum, broad base of the venter in the male and frequently a lateral longitudinal fascia extending from the base to the genital segment; faint spots on the femora.

Head nearly one-third wider across eyes than long (57:38); eyes strongly protruding beyond the anterior angles of the pronotum; vertex two and three-fourths times wider than an eye (33:12); bucculae very greatly elevated throughout, ending abruptly at base of head, the lower edges straight. Antenna with the basal segment extending beyond apex of head by nearly one-half of its length, second segment just over twice as long as basal, third and fourth segments nearly equal in length, each about one-third shorter than second, relative lengths are as 20:44:30:32. Pronotum just over one and one-half times wider than long (68:40), coarsely punctate, much wider across humeri than head across eyes (68:57); lateral margins distinctly, concavely arcuated opposite the cicatrices which are clean-cut, disconnected in the middle and not quite reaching the lateral margins on each side. Scutellum nearly one-fourth wider than long (40:30), coarsely punctate, strongly depressed at base; apical carina distinct. Corium opaque; very sparsely covered with fine recurved hairs; veins strongly elevated; R+M distinctly forked before base of the membrane; costal margins contracted at base and there parallel to each other for a distance equal to the length of scutellum, thence strongly flaring and gently rounding to apices of the corium; this contracted part with a few fine hairs, frequently abraded. Membrane hyaline, extending but little beyond apex of abdomen, its outer margin a little less than half as long as the costal margin. Length 5.00–5.75 mm.

Type males: Plain City, Utah, VIII-5-03. Six paratypes, males and females, as follows: Four with the same data as the type; one, mouth Bear River, Utah, XI-30-14 (A. Wetmore); one, Chambers' Lake, Larimer County, Colo., VII-13-1896 (Baker). All in U.S.N.M.

Distribution: Only the specimens mentioned above have been seen. Its complete range will be made known by further collecting.

This species is most closely related to *angustatus* from which it can best be distinguished by difference in color, size, more elevated bucculae, longer antennae, and more distinctly elevated veins of the corium.

Nysius groenlandicus (Zetterstedt)

Lygaeus groenlandicus Zetterstedt, 1840, Ins. Lapon., p. 262.

Nysius groenlandicus, Stål, 1874, Enum. Hemip. **4**, p. 121.—Van Duzee, 1917, Cat. Hem. N. Amer., p. 159.—Lindberg, 1935, Skrifter om Svalbard og Ishavet No. 65, pp. 11–17 (synonymy, life history, distribution, etc.)

Nysius ericae obscuratus Horvath, 1890, Rev. d'Ent. **9**: p. 188 (*teste* Lindberg, 1935).

General color cinereous, in part heavily marked with fuscous as follows: Head, broadly, on either side of the middle testaceous portion, cicatrices broadly, and punctures of pronotum, the scutellum, corium with outer edge, veins, and posterior margin, conspicuously, venter of abdomen except for a few vague testaceous spots posteriorly, and spots on the femora which often merge to form a uniform color.

Head about one-third wider than long; bucculae, as in *ericae*, higher in front, gradually tapering posteriorly, ending at a point just a little before base of head. Antennae with second segment twice as long and the third nearly one-third longer than basal, terminal subequal to second segment. Pronotum nearly one-third and the scutellum about one-fifth wider than long. Corium contracted at base for a distance equal to two-thirds the length of scutellum, contracted part densely pilose; surface densely coated with fine, appressed hairs, usually devoid of longer erect hairs; maculae of veins often merge to form continuous lines. Membrane clear, faintly marked with fuscous along middle of disk: basal part from apex of commissure to apices of coria shorter than remainder of membrane beyond coria. Length, male, 4.10; female, 4.30–4.50 mm.

It is rather surprising that Lindberg followed Zetterstedt in relating this species to *thymi* rather than to *ericae* inasmuch as Horvath in 1890 recognized it as related to *ericae*. Horvath erected in *ericae* the variety *obscuratus* which Lindberg has cited as a synonym of *groenlandicus*. In fact, it is very closely related to *ericae*, having the general facies of larger, more pilose, darker specimens of that species.

Lindberg gives the distribution of *groenlandicus* as: Greenland, Hudson Bay Territory, Labrador (from Van Duzee), northern Norway, northern Sweden, northern Finland, northern Russia, Siberia, northern China, Turkestan, and northern India.

Recently received specimens from Dr. G. S. Walley, of Ottawa, extend the range of this species in Canada as follows: Churchill, Manitoba; Bradore Bay at the extreme eastern end of Quebec; and Prince Edward Island in the Gulf of St. Lawrence.

LIST OF SPECIES OF NYSIUS WITH SYNONYMY

1. *californicus* Stål, 1860
   major Berg, 1878
2. *californicus alabamensis* Baker, 1906
3. *basalis* Dallas, 1852
   ?callifer Stål, 1874
   ementitus Distant, 1893
   inaequalis Uhler, 1894
   californicus providus Baker, 1906 (not Uhler)
4. *adjunctor*, n. sp.
5. *angustatus* Uhler, 1877
   coloradensis Baker, 1906
6. *grandis* Baker, 1906
7. *thymi* (Wolff, 1804)
8. *ericae* (Schilling), 1829
   niger Baker, 1906
   angustatus of authors (not Uhler)
9. *raphanus* Howard, 1872
   destructor Riley, 1873
   strigosus Uhler, 1894
   minutus Uhler, 1895
10. *monticola* Distant, 1893
11. *tenellus*, n. sp.
    strigosus of authors (not Uhler)
    senecionis Baker (not Schilling)
12. *insoletus*, n. sp.
13. *groenlandicus* (Zetterstedt, 1840)
    ericae obscuratus Horvath, 1890

KEY TO SPECIES (MALES)

1. Bucculae very short, not extended beyond middle of gular region of head; basal segment of rostrum extended nearly to base of head 2
   Bucculae much longer, well extended beyond middle of gular region, often reaching base of head, not at all or very little longer than basal segment of rostrum 5
2. Pronotum distinctly, longitudinally calloused on each side of middle line; veins of corium very faintly, if at all, spotted; color pale testaceous ..... *basalis* Dallas
   Pronotum not distinctly longitudinally calloused; veins more or less heavily spotted with fuscous; color cinereous to fuscous 3
3. Costal margin of corium very slightly, if at all contracted at base; length 4.00 mm ..... *adjunctor*, n. sp.
   Costal margin of corium contracted at base for a distance equal to about one-third the length of scutellum. Length 4.75 mm or more 4
4. Length 5.50–7.00 mm; distribution, western North America, Mexico, Central America, and South America as far south as Argentina ..... *californicus* Stål
   Length 4.75 mm; distribution, eastern North America, Dominican Republic, and Cuba; darker, with shorter antennae ..... *californicus* subsp. *alabamensis* Baker
5. Bucculae high in front, slightly narrowing posteriorly, ending abruptly a little before (in *thymi*) or at base of head; scutellum and genital segment of male either entirely black or bicolored 6
   Bucculae low, gradually fading out to end at a point before base of head; scutellum and genital segment of male usually entirely black 10
6. Pronotum, viewed laterally, distinctly depressed before cicatrices; contracted basal part of costal margin devoid of fine hairs; membrane clear; basal part between apex of commissure and apices of coria distinctly shorter than apical part of membrane beyond apices of coria; color typically pale yellow testaceous, with inconspicuous pilosity; length 3.60–4.00 mm ..... *tenellus*, n. sp.
   Pronotum, viewed laterally, not depressed anteriorly; contracted basal part of costal margin with fine hairs, often abraded; basal part of membrane between apex of commissure and apices of coria longer than apical part beyond apices of coria 7
7. Large species, over 5 mm long; bucculae more strongly raised than in *angustatus*, their length is to the first segment of antenna as 28:20; pronotum wide, in relation to length it is as 70:45; color typically pale yellow testaceous with slight indications of maculae on the prominent veins; corium with very fine, short, appressed hairs; scutellum broadly pale on either side of middle; length 5.0–5.75. mm ..... *insoletus*, n. sp.
   Size usually smaller; relative proportions of pronotum and scutellum otherwise; bucculae shorter and less raised; color cinereous with more conspicuous fuscous punctations and maculae 8

8. Form more robust; width of head across eyes is to the greatest width of pronotum as 50:60. Head and pronotum appearing more flattened; antennae longer, 2.80 mm; corium darker, somewhat rusty cinereous; scutellum entirely black; length 4.80–5.00 mm. . . . . *grandis* Baker

Form less robust; width of head across eyes is to the greatest width of pronotum as 45:52; head and pronotum less flattened; antennae shorter, 2.12 mm; scutellum either entirely black or bicolored; size averages smaller, 4.00–4.30 mm long. 9

9. Contracted part of costal margin of corium usually shorter in relation to length of scutellum, about as 15:23, and in relation to the expanded part of costal margin, as 15:75; first segment of rostrum a little shorter than bucculae; scutellum bicolored; length, 4.25–4.50 mm. . . . *angustatus* Baker

Contracted part of costal margin usually longer in relation to length of scutellum, about as 20:24 and in relation to the expanded part of costal margin, as 20:65; first segment of rostrum equal to or a little longer than bucculae; scutellum entirely shining black; length 3.60–4.00 mm. . . . . *thymi* (Wolff)

10. Pronotum short, nearly twice as wide as long (40:22) and subequal to length of head, costal margins of corium usually subparallel to each other, very little if at all expanded posteriorly; basal part of membrane from apex of commissure to apices of coria much shorter than apical part beyond apices of coria; smaller species 3.10–4.00 mm long. . . . . *raphanus* Howard

Pronotum longer, much less than twice as wide as long (45:28) and usually a little longer than head; costal margins of corium not parallel to each other, parallel only at base, thence expanded posteriorly; basal part of membrane from apex of commissure to apices of coria more nearly equal to apical part beyond apices of coria; larger species 3.25–4.50 mm long. 11

11. Corium with erect hairs as well as dense coating of short appressed pubescence; length 3.80 mm. . . . . *monticola* Distant

Corium with appressed pubescence, usually without erect hairs. 12

12. Corium and membrane more or less broadly infuscate; contracted basal part of corium rather densely pilose; length, male, 4.10 mm; female, 4.30–4.50 mm. . . . . *groenlandicus* (Zetterstedt)

Corium and membrane pale, with fuscous markings usually restricted to corial veins; contracted basal part of corium sparsely pilose; length 3.25–3.70 mm. . . . . *ericae* (Schilling)

ZOOLOGY.—*Notes on myiasis of the toad,* Bufo boreas boreas *Baird and Girard.*[1]

MAURICE T. JAMES, Colorado Agricultural Experiment Station, and T. PAUL MASLIN, Colorado A. & M. College.

On July 19, 1946, on a collecting expedition into Jackson County, Colo., the authors observed a case of myiasis of the mountain toad, *Bufo boreas boreas* Baird and Girard. The specimen was collected at an altitude of 9,500 feet in a small swampy meadow near the Columbine Camp Ground, Routt National Forest, U. S. Highway No. 40. When first sighted the toad lay extended on its side in the sun in a small semicleared area. Two large lesions were visible on the exposed flank. After the toad was captured, it was observed that these lesions were clean with smooth raised edges, each one measuring approximately 8 mm in diameter and containing a mass of small maggots. These were not counted, but it was estimated that there were approximately 30 in each lesion. The closely packed maggots were so oriented that their posterior extremities formed a granular pavementlike surface in the opening of the lesion. In addition to these two a third lesion was found on the dorsal surface of the tibia; though smaller, it included about one-half of the tibial gland. One or two maggots were extracted and examined. This disturbance caused the rest of the maggots to move about restlessly and to work deeper into the lesions. The maggots were not all of the same size; they varied from approximately 3 to 4 mm in length. The toad, active and apparently normal in every respect, was placed in a damp bag with three other toads of the same species and brought to Fort Collins, Colo.

On July 20 the bag was opened and the specimens examined. The infected toad was less active than the other three, and its lesions, as well as the maggots within them, were appreciably larger. The flank lesions could be moved freely with the skin over the undamaged body wall beneath; but the

[1] Colorado Agricultural Experiment Station Scientific Journal Series No. 241. Received April 24, 1947.

tibial lesion was seen to involve the underlying muscles.

On July 22 the specimens were again examined. The three uninfected toads appeared perfectly normal, but the infected one was dead. The maggots were much larger and showed definite indications of being negatively phototropic and positively thigmotropic. When left undisturbed they worked in the exposed lesions, but movements of the carcass caused them to retreat to the lower surfaces beneath the mass. The maggots now retained no definite orientation within the extensive lesions but worked independently under the adjacent areas in the cutaneous lymph sinuses or deeper into the abdominal cavity and muscles. As the maggots had still shown no indication of abandoning the carcass, it was transferred from the bag and placed on damp sand in a wide-mouthed jar. This was closed by taping the mouth of a second jar, partly filled with damp mud and sand, to its open end.

On July 23 it was noted that most of the maggots were still feeding and had grown appreciably. The toad was rapidly disintegrating through putrefaction and the action of the maggots. A few maggots had abandoned the carcass and the glass was marked with their tracks. There were also indications in the sand that some of the maggots were seeking retreats to pupate.

During the following three days the substance of the carcass rapidly disappeared and more and more maggots left the carcass for the sand; but a large number still remained in the putrefactive fluid in the sand around the now exposed bones.

Observations were discontinued until July 29. By this time a number of flies had emerged. Though the flies were dead and most of them in a disintegrated condition, a positive determination of *Bufolucilia elongata* (Shannon) was made. No more adults were recovered, but the determination was further confirmed through the examination of dead imagines within the puparia. A total of 76 puparia, either empty or containing dead imagines was obtained, in addition to ten larvae which had been extracted from the lesions on July 23.

On August 2 adults of *Muscina stabulans* (Fallen) began to appear, and on August 5 one adult of *Sarcophaga sarracenioides* Aldrich was obtained. These two species continued to emerge until August 10, by which time 70 individuals of the former and 9 of the latter species had been obtained. On August 19 the disintegrated substrate was torn apart and examined for pupal cases. During this process, five larvae of *Fannia canicularis* (Linnaeus) were obtained; two of these were reared for purposes of confirming the identifications.

All larvae extracted from the lesions on July 23 were *B. elongata*. This fact, together with the lapse of time before the emergence of the other species, indicates with fair certainty that this was the only species involved in the original parasitism. How the subsequent infestation occurred could not be determined. The *Fannia* larvae were undoubtedly scavengers; two of them, indeed, were taken within the eaten-out puparia of *B. elongata*. The *Muscina* larvae, which are notoriously carnivorous in their last instar, may have been responsible for the destruction of the *B. elongata* adults.



Fig. 1.—*Bufolucilia elongata (Shannon) Pharyngeal sclerite*

The immature stages of *B. elongata* have not been described. The larval material at hand is too scant to permit a detailed description, but enough cephalopharyngeal skeletons were studied by the senior author to permit separation of the third instar, on this basis, from the only other known species of the genus, *B. sylvarum* (Meigen). The characters used are constant for the series studied, which includes cleared material obtained from the puparia, material in situ in the puparia, and a cleared specimen of a larva newly moulted into the third instar.

The larva of *B. sylvarum* was described

and illustrated by Knipling.[2] In *B. elongata* the oral hooks and hypostomal sclerite seem to show no significant differentiating characters. The pharyngeal sclerite (Fig. 1), however, is more robust; the dorsal cornu is more evenly convex and does not bend so strongly ventrad at its apex; and the ventral cornu at its apex does not approach the dorsal cornu so closely. Seemingly the most important differentiating character is the extent of sclerotization, the dorsal cornu being heavily sclerotized along its entire ventral margin, with a prominent expanded area at the apex.

[2] KNIPLING, EDWARD F. Iowa State College Journ. Sci. **10**: (3); 275–293. 1936.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

GEOLOGICAL SOCIETY

634TH MEETING

The 634th meeting of the Society was held at the Cosmos Club, January 9, 1946, president W. H. BRADLEY presiding. A memorial to C. W. Gilmore was read by C. LEWIS GAZIN.

Informal communication.—HUGH D. MISER presented statistics on American Association of Petroleum Geologists.

Program.—PHILIP W. GUILD and D. E. FLINT: *Chromite deposits of Camagüey Province, Cuba.* The chromite-bearing ultramafic complex near Camagüey, Cuba, mapped as a part of the program of mineral investigations of the U. S. Geological Survey, consists chiefly of serpentinized peridotite (harzburgite) and dunite, with minor amounts of the feldspathic rocks: gabbro, troctolite, and anorthosite. This complex and the overlying Cretaceous tuffs and limestones were severaly deformed in an orogeny which culminated in extensive thrust faulting, probably in late middle Eocene time. The sedimentary rocks now occur in two synclinal arcs extending across the district parallel to the trace of the thrust. The feldspathic rocks of the complex flank the tuffs along the limbs of the syncline, indicating that they were concentrated in the upper part of the complex.

The chromite occurs as tabular or lenticular bodies of massive, coarse-grained, or occasionally fine-grained disseminated ore. Virtually all the known deposits are near the base of the feldspathic zone, but with an irregular lateral distribution which distinguishes them from the layered chromitites of the Bushveld-Stillwater type. Two possible modes of origin are discussed: (1) segregation of the deposits near the feldspar-peridotite boundary after emplacement of the magma through some process of gravity separation and magmatic flow; (2) differentiation of chromite at great depth before intrusion and transportation of the ore bodies as solid masses to their present position. The grouping into clusters, as though near feeders, and the massive texture and sharp contacts of many of the deposits suggest that the latter hypothesis is more probable.

A practical aspect of the study has been to suggest improvements in the pattern of future geophysical surveys.

JARVIS B. HADLEY: *Corundum deposits in Buck Creek peridotite, North Carolina.*

G. D. ROBINSON: *The 1945 eruption in Tulik Caldera, Umnak Island, Alaska.* The Alaska Peninsula and the Aleutian Islands comprise one of the more active but least known of the series of volcanic arcs which border the Pacific Ocean. The Aleutian volcanic arc includes about 80 large volcanic mountains, of which about 40 are known to have been active, some many times, since 1760, the earliest year of record. In 1945 a spectacular eruption on Umnak Island, third largest of the Aleutians, aroused much attention because it occurred only 9 miles from Fort Glenn, a large Army airbase. The writer observed the eruption at its explosive climax (June 6–June 10), but Lt. Ray E. Wilcox made most of the observations presented.

One of the world's largest calderas, formed by the decapitation of a peak once 7,000 to 10,000 feet high, dominates the northeastern part of Umnak Island. The caldera is $6\frac{1}{2}$ to $7\frac{1}{2}$ miles wide; its rim lies at altitudes of 2,900 to 3,900 feet; its walls drop abruptly 1,000 to 2,000 feet to the caldera floor. Disposed about the floor are nine large volcanic cones and many small ones.

A large cone near the southwestern edge of the caldera floor erupted violently in 1945. The eruption, preceded by a few mild earthquakes late in May, seems to have begun about June 4; on June 6 a dense ash cloud rising to 9,000

feet could be seen by fliers, but bad weather prevented detailed observation until June 10. On that date, steam rushed steadily from the crater at about 2,500 feet altitude, sending a white cloud to altitudes of nearly 5,000 feet. An explosion about every 10 seconds threw orange-hot bombs and lapilli, and black ash, as much as 1,500 feet above the vent. A stream of olivine basalt lava about 50 feet wide was flowing eastward from the southwest base of the cone at a rate of 30 to 40 feet per minute and was about 3,000 feet long; another, shorter ribbon of lava was flowing west into a shallow depression. Explosive activity diminished after June 10 and by July 22 the crater vent was discharging only a small steam condensation cloud; the main lava tongue had practically stopped flowing after reaching a length of 4 miles and a maximum width of 600 yards. A slight renewal of activity occurred in December 1945, when a little lava flowed from the northwest base of the cone and a large ash cloud rose above it for a few days.

This eruption, though far from being an outstanding volcanic event, has served to focus attention on the vulnerability of military establishments in the Aleutian Islands–Alaska Peninsula area to destructive volcanism, as well as to emphasize the scarcity of information about this great volcanic region. Largely in consequence of this eruption, long-needed funds have been made available to the Geological Survey for beginning a program of volcano investigations in Alaska.

(Author's note: The name Tulik caldera—for Mount Tulik, a prominent parasitic cone on the southeast flank of the decapitated volcano —seemed appropriate when the paper was given. It has since been learned that the native name for the decapitated volcano is Okmok and the caldera is therefore more properly called Okmok caldera.)

635TH MEETING

The 635th meeting of the Society was held at the Cosmos Club, January 23, 1946, Vice-president JOHN C. REED presiding.

Informal communication.—MARCUS I. GOLDMAN discussed an outfit for carrying acid in the field.

Program.—JOHN A. STRACZEK: *Manganese deposits in eastern Cuba.* Manganese deposits of eastern Cuba occur in a thick series of volcanic and sedimentary rocks of middle Eocene age which crop out in the Sierra Maestra and its northern foothills and in the southern foothills of the Sierra de Nipe. Water laid tuffs and agglomerates of andesitic character, interbedded with lenses of limestones, compose the bulk of the rocks of the formation although some flows and many small intrusives are present. These rocks are gently folded and are broken by many faults. Although manganese deposits occur throughout the section of pyroclastic and sedimentary rocks the bulk of the economically important deposits are localized in the upper part of the formation.

The manganese deposits may be grouped into three main divisions: bedded, nonbedded or irregular, and residual. The bedded deposits are economically and quantitatively most important. They are tabular bodies in tuff or limestone that do not appear to be associated with faults, The nonbedded deposits are irregular crosscutting bodies, commonly in limestone, that in some cases appear to be localized along faults or fractures. Residual deposits are surficial accumulations of manganese oxides formed by the weathering of primary irregular or bedded deposits.

Primary psilomelane-type manganese oxides form the chief manganese mineral of the deposits and pyrolusite, manganite, and braunite are common. Other manganese minerals include several varieties of manganese silicates. Gangue minerals include jasper, clay minerals of the montmorillonite group, calcite, zeolite, and celadonite(?).

Accumulated evidence supports the thesis that the bulk of the deposits are syngenetic and that structural control did not play an important part in their localization. General concordance of the deposits, the fact that intraformational conglomerates consisting of angular fragments of psilomelane-type manganese oxides cemented by limestone or tuff overlie many of the ore beds, and the fact that clastic dikes of foraminiferal limestone or of tuff crosscut many of the beds strongly supports a syngenetic origin. Yet these same deposits exhibit features which show that both limestone and tuff have been replaced by manganese oxides and locally transgress the bedding of the enclosing rocks. Warm hydrothermal solutions associated with centers of volcanic activity are believed to have risen along

conduits and to have deposited their loads at or near the tops of of pyroclastic and limy beds where the manganese oxides and associated elements were precipitated in the presence of sea water; some oxides were discharged directly on the sea floor but some replaced tuffs and limestones at or near the surface of deposition. These solutions altered tuffs to clay and other minerals and deposited jasper. The fact that many of the manganese deposits are associated with limestone is believed fortuitous; conditions favorable for the deposition of manganese and associated elements were also favorable for the deposition of limestone, both limestone and manganese deposits having been formed during temporary lulls between periods of more violent volcanic activity. The irregular deposits are believed to have been formed along faults and fractures formed during the long period of vulcanism and sedimentation.

As very little research has been done on the mineralogy of the deposits no theory can yet be advanced for the chemistry of deposition of the ores.

GEORGE O. GATES: *Recent exploration for oil in Naval petroleum reserve No. 4, Alaska.*

V. E. MCKELVEY and J. BALSLEY: *Distribution of black sands along part of the south Atlantic Coast as mapped from an airplane.* Black sand beach concentrates are more widely distributed along the beaches of North Carolina, South Carolina, and Georgia than has been recorded heretofore, as shown by a map prepared by airplane reconnaissance. The map shows also that the black sands diminish in abundance northward, that their distribution is in part related to the configuration of the shoreline, and that they are found only on beaches along the open sea.

636TH MEETING

The 636th meeting of the Society was held at the Cosmos Club, February 13, 1946, President W. H. BRADLEY, presiding.

Informal communications.—MICHAEL FLEISCHER called attention to the publication Chemical Abstracts, where references to literature on Chemical Geology may be found.

S. E. CLABAUGH discussed the Spiral Concentrator used by Humphreys Gold Operators on the black sands in Florida.

R. H. JAHNS discussed the program of muscovite testing during 1945.

Program.—W. T. PECORA, M. R. KLEPPER, and D. M. LARRABEE: *Mica-bearing pegmatites in Minas Gerais, Brazil.* In the period 1900–45 about 8,500 metric tons of processed muscovite mica were exported from Brazil, and of this amount about 60 percent has been exported since 1940. The total mine production since 1900 is estimated to have been about 90,000 tons of crude mica. Prior to 1943, almost all the production was derived by hand mining. In the period 1943–45, some 30 mines employed earth-moving equipment in open pit operations and some 20 used air-compressor for underground rock drilling. As a result of the stimulated war production a number of mines have seriously depleted indicated reserves but others have developed even greater reserves.

More than 85 percent of the mica mines and prospects are located in the eastern part of the state of Minas Gerais and about 95 percent of Brazilian production has come from this state. Other mica-producing states are Rio de Janeiro, São Paulo, Espirito Santo, Bahia, and Goaiz.

In size, the mica-bearing pegmatites range up to hundreds of meters in length and up to tens of meters in thickness. In form they are tabular, lenticular, irregular, and ramiform. They occur in a wide variety of igneous and metamorphic rocks that are assigned by Brazilian geologists to ages ranging from the Archaean to upper Algonkian. Pegmatites in quartzite, gneiss and igneous rocks are commonly discordant, well-formed, tabular or lenticular masses; whereas those in mica schist are concordant, quasiconcordant, and discordant and include a wide variety of forms.

An internal zoning based on mineral association and texture has been recognized for a great number of mica-bearing pegmatites The zoning is simple or multiple, symmetric or asymmetric. The bulk of the Brazilian mica production has come from zoned pegmatites. In general, a more complex mineral assemblage occurs in the pegmatites of northeastern Minas Gerais.

Local exceptional concentrations of muscovite mica, related to external or internal structural features, are termed mica shoots. A single pegmatite may have more than one mica shoot. The percentage of mine-crude mica ranges up to 20 percent in the shoots, and the quantity of mine-crude ranges up to a few thousand tons.

Beryl, tantalo-columbite, gem stones, and kaolin have been recovered from a number of pegmatites containing mica. Lithia minerals occur in several pegmatites but have received no commercial attention. The indicated reserves of mica and associated industrial minerals in northeastern Minas Gerais are greater than those in the more accessible southeastern part of the state. The mica industry as a whole and many mica mines in particular are more firmly established for postwar production than they were in pre-war years.

G. Edward Lewis: *Tertiary geology of northeastern Wind River Basin.* Recent work by the United States Geological Survey has amplified considerably our knowledge of the geology of the northeastern Wind River Basin. A lithologic unit which contains a fossil vertebrate fauna intermediate between those of the Uinta and Chadron formations has been recognized in the area for the first time, and is correlated with the Duchesne River formation.

Frank A. Swenson: *Geologic work for military forces on Iwo Jima, Okinawa, and in Korea.* As a member of the Engineering Terrain Intelligence Team of the U. S. Geological Survey the writer helped make detailed plans for the Iwo Jima and Okinawa operations and took part in them as a geological consultant.

One month, from March 10 to April 10, was spent on Iwo Jima. This island consists of two volcanic cones, the younger, Mount Suribachi is at the southern end, and the older makes up the northern bulge of the island. Between them there is a thick deposit of loose black volcanic cinder derived from Mount Suribachi. No surface water or springs are present. Japanese obtained water from shallow wells dug in beach area, by distillation of sea water, by storage of runoff from airfields and from small prepared catchments, and by condensation of steam from numerous fumeroles. American forces obtained fresh water by drilling wells to sea level in volcanic cinder plain between volcanic cones. Fresh-water lens stands from 7 to 15 feet above sea level in wells drilled. Wells have high specific capacities and it is estimated that at least one million gallons per day may be developed. Water ranges in temperature from 100° to 180° F. and is somewhat mineralized but is entirely potable. Rock for surfacing of airfields was obtained by crushing andesite cobbles from a raised beach. Boulders were derived mainly from wave erosion of the andesite plug underlying Mount Suribachi.

After Iwo Jima, five months were spent on Okinawa obtaining water supplies, locating soft coral pits and hard limestone quarries and giving advice on engineering geology problems of airfield drainage and construction. The chief water-bearing bed was the coralline limestone. Numerous springs, some of large size, issued from the base of this limestone. Wells drilled in the limestone obtained good supplies in most cases. In places it was necessary to construct infiltration galleries to skim fresh water from beach deposits. Numerous soft coral deposits were located and pits were opened in them to provide the great quantities of coral needed for airfield and road construction. Hard limestone quarries were opened to furnish crushed rock for airfield and road surfacing.

After VJ day John Wiese, S. Neuschel, and the writer accompanied the XIV Army Corps to Korea. Work there consisted mainly of visiting and investigating all mining properties in the American occupied zone. Anthracite, molybdenum, and tungsten mines were most prominent, but mines producing gold, silver, zinc, copper, lead, cobalt, nickel and corundum were visited.

637TH MEETING

The 637th meeting of the Society was held at the Cosmos Club, February 27, 1946, President W. H. Bradley presiding.

Informal communications.—S. E. Clabaugh exhibited the Mineral Resources maps of the Missouri River Basin, recently released.

L. G. Henbest discussed Permian chert cobbles from the gravel beds of Eocene age in the Ozarks.

Program.—Esther W. Claffy: *Spectrochemical analysis of rocks and minerals.* Spectrochemical methods used in the U. S. Geological Survey laboratory are adjusted to the problems of rock and mineral analysis. About 70 chemical elements are determined—major constituents qualitatively, minor constituents quantitatively. The finely powdered sample, weighing 20 mg or less is burned in a carbon anode, using the direct current arc. Because of the small size of the sample and the inherent sensitivity of the method sampling

errors must be minimized. Where traces of Cu, Sn, and Pb are in question soldered copper sieves cannot be employed during sample preparation. Specially purified electrodes are used where contamination from Cu, V, B, Ag, Mg, or Pb is undesirable.

A medium-sized quartz spectrograph records the entire spectral range 2200Å–8600Å on a single plate. For greater dispersion a large Littrow quartz spectrograph or a grating spectrograph is used. The spectrograms are complicated by background lines from carbon and from silicon monoxide and cyanogen bands. Sensitive lines of 45 of the 70 determinable elements are located in the ultraviolet region comparatively free from such interferences. For ordinary work results are accurate to one significant figure. Two significant figures can be attained for special problems.

Comparison standards are generally prepared by incorporating the desired element, preferably as the natural mineral, into a synthetic rocklike mixture of feldspar, quartz, and iron oxide. Intensity of spectral lines of an element is influenced by its state of chemical combination and the nature of the matrix. For accurate results standards must closely approximate the "unknown" sample in chemical and mineralogical composition. Tin is peculiarly sensitive, a silicate base causing an appreciable and nonuniform deviation in line intensity as compared with a ludwigite mineral base. Sensitivity of detection varies with the elements. Alkaline earths, Li, Na, Ni, Cu, Ag, and Ti, can be detected at 0.001 percent. Sb, As, and many rare earths can not now be detected below 0.01 percent. Use of special techniques sometimes extends the lower limits. Among the limiting factors may be inherently weak spectral lines, extreme volatility, extreme refractoriness, and interference by lines of other elements present.

ROBERT E. WALLACE: *Notes on permafrost investigations in Alaska.* Permafrost is perennially frozen ground in which ice or freezing temperatures exist the year around. Approximately one-fifth of the land surface of the world is underlain by permafrost. Some of the economic aspects of permafrost include its effect on construction and maintenance of roads, buildings, water supply and disposal facilities, airfields, and in the development of agriculture.

Certain basic aspects of the problem can best be attacked by men trained in geology because permafrost is essentially a geologic phenomenon. Some of these geologic problems are: the relationship and effect of permafrost on ground and surface water, relationship of soil types to the nature and distribution of permafrost, and the effect of permafrost on physiography. For example, one principal problem in choosing the site for the installation of a road, airfield or building is to determine which areas of ground will be subject to slumping upon thawing of permafrost and which areas will remain stable. As might be expected, this unstable type of ground has its manifestations in the physiography of the area. One outstanding physiographic expression of this condition is the "cave-in lake" or "thermokarst lake." A study was made of cave-in lakes in Alaska in connection with the Geological Survey's permafrost project which is being conducted in cooperation with the office of Chief of Engineers. This study revealed some of the characteristics of cave-in lakes, making it possible in many cases to identify them with considerable certainty in aerial photographs as well as by ground examination and thus to be forewarned of "dangerous" permafrost ground.

In the lower parts of the Nabesna and Chisana River Valleys stages of a cave-in lake cycle were observed. The pattern of an incipient cave-in lake is typically circular. As thawing proceeds and the banks retreat away from the centers of the lakes, individual lakes are joined to other lakes and aggregates of lakes result. Eventually groups of lakes are integrated and drainage takes place through them. Many of the lakes observed in the Nabesna and Chisana flood plains were at approximately river level. Once a group of lakes in such a position become joined to the river they are alternately flooded and drained as the river level rises and falls. This flooding and draining causes natural levees to be formed along the drainage channels which cross the lake basins. In time the natural levees separate the lakes basins into parts, and in the old age stages of the cycle constitute the principal land areas, the rest being principally areas which have caved and formed lake basins.

DAVID A. ANDREWS: *Significance of stylolites in sandstone.* Diamond drill cores of formations of Pennsylvanian age in western Maryland and northeastern Alabama contain stylolites in the sandstones of all the formations encountered. The stylolites are sparse in

some sandstones but are rather abundant in the quartzitic sandstones. They have the characteristic jagged or hackled form of stylolites in limestone and they have amplitudes of up to 2 inches. As they show slickensides, they were formed after consolidation of the sandstone. Thin sections indicate solution of nearly all quartz grains in contact with the stylolites ranging from slight to almost complete obliteration of individual grains. Residual clay and carbonaceous materials are present in most places along the stylolite seams.

Though references in geologic literature to stylolites in sandstone are rare, their abundance in these two localities, 600 miles apart along the eastern margin of the Appalachian Plateau Province, leads one to question whether they are not more abundant than heretofore observed or recognized.

The Appalachian Plateau Province is not a mineralized belt, and there is no evidence of hydrothermal action in these two areas unless the presence of dickite associated with the stylolites in Maryland is regarded as indicative of a temperature of 100° C. for the solutions that deposited the dickite and interstitial quartz. The maximum cover in western Maryland probably did not exceed 3,000 feet. There probably was an increase in thermal gradient during folding of the Appalachian Mountains.

These data lead to significant but unsolved questions: (1) May the solution of quartz have been more extensive than is indicated by the stylolites? (2) Was this fairly extensive solution of quartz accomplished by normal ground waters?

638TH MEETING

The 638th meeting of the Society was held at the Cosmos Club, March 13, 1946, President W. H. BRADLEY presiding.

New business.— W. G. SCHLECHT offered a resolution urging the adoption of the original McMahon bill for control of atomic energy.

Informal communication.—H. SHELTON exhibited a new type of topographic map with which the Geological Survey is experimenting.

Program.— LLOYD G. HENBEST: *The Morrow group of northwest Arkansas.* The type sections of the Morrow group and its subdivisions are located in Washington County, Ark. The Morrow group occupies a key position in the classification of the Lower Pennsylvanian. Though the Morrow group has been the subject of considerable study, certain misconceptions on its stratigraphy are being perpetuated. The Hale formation, instead of being an irregular complex of crossbedded sediments, is divisible into two units that are rather widely distributed and have distinctive features. The lower unit is locally misidentified as belonging to the Fayetteville shale, and part of the upper unit is very generally misidentified as the Brentwood limestone member of the Bloyd shale. In at least one instance the upper unit has been confused with the Pitkin limestone, Mississippian. Of the outstanding residual Mississippian elements in the Morrow fauna *Pentremites* is obviously indigenous and *Archimedes* evidently redeposited from the Pitkin limestone. *Millerella,* which is widely characteristic of marine sediments of Morrow age, is present also in the Pitkin fauna of late Mississippian age. This is the earliest stratigraphic record so far authenticated for a member of the family Fusulinidae.

K. J. MURATA and ROBERT L. SMITH: *Red fluorescing halite from California and Idaho.* The bright red fluorescence of halite from California dry lake deposits and from a salt spring in Idaho is due to coactivation by minute amounts of manganese and lead. Neither manganese nor lead alone activates the red fluorescence. Chemical, spectrographic, and synthetic experiments, which identify manganese and lead as coactivators and throw light on the mode of coprecipitation of these elements by growing halite crystals, are described. The marked preferential coprecipitation of lead by growing halite crystals results in zoning of fluorescence in crystals and restriction of fluorescence to the first crops of crystals, when the supply of lead is limited.

JOHN G. CADY: *Application of soil science in geology.*

639TH MEETING

The 639th meeting of the Society was held at the Cosmos Club, March 27, 1946, President W. H. BRADLEY presiding.

Informal communication.—GERALD FITZGERALD discussed the Geological Survey's experiments with relief models.

Program.—O. E. MEINZER: *General principles of artificial ground-water recharge.* Paper published in Economic Geology **41**: 191–201. 1946.

HERBERT E. HAWKES, Jr.: *Magnetic exploration for Adirondack iron ore.* In June 1945, the Geological Survey completed a

magnetic reconnaissance of an area of approximately 3,170 square miles in the Adirondacks of northern New York in an effort to locate hitherto unknown deposits of magnetic iron ore. The reconnaissance work was done with the Magnetic Airborne Detector originally developed for antisubmarine detection by the Armed Services, and adapted for geophysical work by the Geological Survey.

In general, nontitaniferous magnetite is found where the younger granite intrudes metasedimentary rocks of the Grenville series, and such areas were selected for reconnaissance. Aerial traverse lines were spaced at quarter-mile intervals, and lines were flown at an average elevation above the ground surface of 1,000 feet. Following the reconnaissance work, dip-needle surveys were run on about 50 of the more promising magnetic anomalies. Of these, 10 proved to be relatively strong anomalies, whereas the remaining 40 turned out to be broad zones of low magnetic intensity of little commercial interest.

The country is heavily glaciated, and outcrops in general are scarce. In the area surveyed, it is reasonable to assume that all the important magnetite deposits, whether drift covered or not, with a strike length of more than 1,000 feet have been indicated by the airborne magnetometer. From an analysis of these data, it is concluded that at least in St. Lawrence County the number and aggregate extent of magnetite deposits obscured by glacial cover is at least as great as that of the deposits which were found by their outcroppings.

Ralph L. Miller: *Structure of the Cumberland overthrust block in southwest Virginia.* The Cumberland overthrust block covers an area, approximately 125 miles long and 25 miles wide, in southwest Virginia and adjoining Kentucky and Tennessee. The overthrust plane, along which the block has moved to the northwest, has been named the Pine Mountain overthrust from its outcrop along the base of Pine Mountain in Kentucky. Tear faults at the northeast and southwest ends of the Cumberland block separate it from the relatively undeformed sediments of the Appalachian Plateau. To the southeast the block is cut off from the folded and faulted rocks of the Appalachian Valley by two thrust faults, which dip to the southeast at moderate angles. Within the overthrust block are two broad gentle folds, the Middlesboro syncline, which occupies the northwest half of the block, and the Powell Valley anticline occupying the southeast half. Erosion along the crest of the Powell Valley anticline in Lee County, Va. has exposed the rocks beneath the Pine Mountain overthrust in six fensters, which are for the most part confined to valley bottoms. Excellent exposures in the fenster region, and the drilling for oil both inside and outside the fensters has made it possible to work out the history and phenomena of the overthrusting in great detail.

In the fenster area the rocks of the underlying stationary block dip to the northwest in the southern and western fensters but are nearly flat-lying in the northeastern fensters. The formations in this block that are exposed in the fensters range in age from Lower Ordovician to Upper Silurian, and they are enclosed and overlain by limestones and dolomites of Upper Cambrian age.

In much of the fenster region, the Pine Mountain overthrust fault is dual, with slices of much deformed and brecciated rock lying between the two fault planes. Two major slices have been mapped and their limits are accurately known, except where they are entirely concealed by the Cumberland overthrust block. In addition numerous small slivers which have been torn loose from the top of the stationary block, have been dragged along the fault plane and are now exposed around the rims of the fensters. The slivers have moved forward distances varying from a few tenths of a mile up to 2 miles. The total forward movement of the overthrust block in this area is calculated to be 5.8 miles.

The Pine Mountain fault plane developed numerous irregularities during the period of overthrusting as shown by the fact that it now has prominent changes of attitude that are not reflected in the overlying rocks. The arching of the Powell Valley anticline began before overthrusting was completed.

640TH MEETING

The 640th meeting of the Society was held at the Cosmos Club, April 10, 1946, President W. H. Bradley presiding.

Informal communication.—Ruth Schmidt discussed the present status of the Atomic Energy Committee.

Leona Boardman announced the compilation of geologic mapping in the United States.

T. W. Vaughan called attention to a report

on 8,000 gravity stations in Burma published in a recent volume of the Proceedings of the Geologic Society of London.

Program.—G. A. COOPER: *The role of fossils in stratigraphy.*

ERNST CLOOS: *A preliminary report on the geology of Montgomery County, Maryland, and the District of Columbia.*

641ST MEETING

The 641st meeting of the Society was held at the Cosmos Club, April 24, 1946, Vice-President J. C. REED presiding.

Program.—T. S. LOVERING: *Some chemical aspects of hydrothermal alteration in the Tintic district, Utah.*

THOMAS P. THAYER: *Late stages of erosion cycle in tropical rain forests.*

642D MEETING

The 642d meeting of the Society was held at the Cosmos Club, October 23, 1946, President W. H. BRADLEY presiding.

Program.—JOSHUA I. TRACEY, Jr.: *Reefs and Islands of the Marshall group.*

ROGER REVELLE: *Some scientific dividends of the atom bomb tests.* A movie of the Bikini tests was shown.

643D MEETING

The 643d meeting of the Society was held at the Cosmos Club November 13, 1946, President W. H. BRADLEY presiding.

Informal communication.—N. H. DARTON discussed the basis of map projections.

Program.—CLYDE P. ROSS: *Structure of the front of the Bitterroot Range, Montana.* Concepts as to the structure of that portion of the east front of the Bitterroot Range that bounds the Bitterroot Valley were among the byproducts of field work in the summer of 1946 done in connection with the compilation of the western half of a proposed new geologic map of Montana. Lindgren postulated that the gneiss of this mountain front resulted from a normal faulting of low dip, movement on which began soon after the Idaho batholith was emplaced. He emphasized his opinion that "the rocks along it bear evidence of molecular and molar movement." He also presented evidence of steeper normal faulting some of which took place as recently as 1898, the year before he did his field work. Langton, whose field work began in 1932, agreed that the gneiss resulted from normal faulting and, in addition, postulated a thrust fault of easterly dip earlier than the intrusion of the batholith. He supposed this fault to be contemporaneous with the steep thrusts that Clapp inferred to bound the linear ranges of northwestern Montana. Both Lindgren's concepts and those of Langton are difficult to reconcile with the idea now held by several geologists that the Idaho batholith made way for itself, at least in part, by exerting pressure on its walls.

The writer's concept is that the gneissic border zone along the front of the Bitterroot Range in this area is a product of impregnation and replacement of sedimentary rocks of the Belt series (pre-Cambrian) by igneous material from the same source as the Idaho batholith. The gneiss is part of an incomplete border zone composed of metamorphosed sedimentary rocks and intrusive bodies that partially surround the Idaho batholith. Normal faults of undetermined magnitude probably exist along the mountain front but are independent of the gneissic border zone and of the roughly triangular mountain spur ends carved from the gneiss by differential erosion.

OLAF HOLTEDAHL: *The west Scandinavian (Caledonian) Mountain Range.*

HERBERT E. HAWKES, Jr.: *The Geological Survey's geochemical prospecting unit.* The Geological Survey has undertaken a program of research on new methods of prospecting for mineral deposits, based on studies of the geochemical dispersal of minor elements derived by the leaching of buried mineral deposits. Particular emphasis is being placed on the content of zinc, copper, and lead in soil, vegetation, and natural water, and its relation to known or suspected bodies of ore.

Considerable data on the distribution of these elements in surface materials have already been collected by agricultural scientists in their studies of inorganic plant poisons and fertilizers. Their work gives the geologist a broad background of analytical techniques and preliminary geochemical information which can be applied with little modification or reinterpretation to prospecting problems.

Several geochemical field studies are currently in progress, and preliminary results are believed to be sufficiently encouraging to warrant further and more intensive study. The ultimate goal of the Geological Survey's program is the development of a routine method

by which a relatively untrained field party will be able to prospect for hidden mineral deposits by tracing the distribution of minor elements in surface materials.

644TH MEETING

The 644th meeting of the Society was held at the Cosmos Club, November 27, 1946, President W. H. BRADLEY presiding.

Informal communication.—FERNAND ALBERT J. BLONDEL, Chief Geologist of French Territories, discussed recent developments in North Africa.

Program.—WENDELL P. WOODRING: *Marine terrace deposits of mountainous coasts.* The deposits on emerged marine terraces of mountainous coasts are of two classes: marine deposits, generally thin, resting directly on the terrace platform; and nonmarine deposits, invariably thicker, overlying the marine deposits, or in their absence, lying on the terrace platform. The nonmarine deposits, which accumulated after emergence and were derived from the cliff backing a terrace and the highland farther inland, are designated the nonmarine terrace cover. A thick nonmarine cover may extend seaward over the next lower terrace, or still lower terraces, with a smoothly graded profile, completely concealing the sea cliff between successive terraces. A nonmarine cover of that character is designated a multiple cover, as contrasted with a single cover.

Interpretations of the origin of chromite-bearing sands, "associated with" marine terraces along the coast of southern Oregon, fail to account for nonmarine covers, and one interpretation fails also to account for marine deposits.

WATSON H. MONROE: *Recent changes in the stratigraphy of the Gulf Coast Cretaceous.*

WILLIAM D. JOHNSTON, Jr.: *The Geological Survey in Latin America.* Geologic studies in Latin America were begun by the U. S. Geological Survey in 1940, under the auspices of the Interdepartmental Committee on Scientific and Cultural Cooperation of the Department of State. Since 1940, about 40 geologists of the Geological Survey have worked on that program in various countries of Central and South America and in Mexico. Results of some of these investigations have been published, in English, in Bulletins 935 and 946 of the Geological Survey entitled "Investigations in the American Republics"; in Spanish in the Boletins of the Comité Directivo para la Investigación de los Recursos Minerales de Mexico; and in Portuguese, in the Boletins and Avulsos of the Divisão de Fomento da Produção Mineral of the Departamento Nacional da Produção Mineral of Brazil.

During the war years, the Latin American program was focused on the immediate production of strategic minerals. With peace has come a reorientation of the program wherein the focus has been shifted to other mineral deposits, such as iron, lead, zinc, and copper, in which the United States faces serious depletion in its own reserves within the next two decades. This shift in emphasis has been accomplished after frank discussion with responsible officials in various Latin American countries of our respective interests as buyers and sellers of mineral raw materials.

Although approximately 90 percent of the annual budget of the geological program in Latin America is spent on problems in economic geology, some purely scientific studies are maintained. As examples of the latter type might be mentioned the maintenance of an observer at the volcano Parícutin in Mexico and stratigraphic studies in southern Brazil.

645TH MEETING

The 645th meeting of the Society was held at the Cosmos Club, December 11, 1946, Vice-president JOHN C. REED presiding.

Program.—Presidential address by WILMOT H. BRADLEY: *Limnology and the Eocene lakes of the Rocky Mountain region.*

54TH ANNUAL MEETING

The 54th annual meeting was held immediately following the 645th regular meeting. The reports of the Secretaries, Treasurer, and Auditing Committee were read and approved. Officers for the year 1947 were then elected:

President: WENDELL P. WOODRING
Vice-Presidents: ERNST CLOOS, WILLIAM D. JOHNSTON, Jr.
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The Society nominated W. W. RUBEY to be a Vice-President of the Washington Academy of Sciences for the year 1947.

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HISTORY OF SCIENCE.—*Joseph Henry builds an institution.*[1] PAUL H. OEHSER, Smithsonian Institution. (Communicated by JOHN E. GRAF.)

The year 1846 has been called "the year of decision," and indeed it is surprising to see how many important events in the history of our country revolve around that date. It was an exciting period. Things were happening at an appalling rate—appalling at least to a fledgling republic just barely three score and ten years of age.

Most important perhaps was the fact that as a nation we were suffering growth pains, and they were causing us a lot of grief. We were expanding toward the Pacific, treading on the toes of other territorial claimants. In 1846, after several years of heated contest, our argument with Great Britain over the Oregon boundary was settled by treaty, adding to our territory what is now Washington, Oregon, Idaho, Montana, and Wyoming. On our southern border we engaged in another squabble, and in 1846 a 2-year war with with Mexico broke out, from which we gained the area now included in California, Arizona, Utah, and New Mexico. In Congress the Wilmot Proviso was being argued and was causing agitation throughout the country with the possibility that "neither slavery nor involuntary servitude should ever exist in any part of territory acquired from Mexico." John C. Frémont had completed his explorations and conquests beyond the Mississippi, and the year before (1845) the Senate had published his reports full of descriptions of the new country and its possibilities. One of his thousands of readers, we are told, was Brigham Young, who thereby was inspired to lead his zealous band of Mormons westward in 1847 into the "Promised Land," the Great Salt Lake country.

The boundaries of knowledge, too, were expanding. In 1846 William T. G. Morton, a Boston dentist, demonstrated the successful use of anesthesia in surgery, of which the British medical journal *Lancet* said, "Next to the discovery of Franklin, it is the second and greatest contribution of the New World to science." Two years earlier, Samuel F. B. Morse, applying the electromagnetic discoveries of Faraday and Henry, demonstrated the practicability of the telegraph, which was soon to revolutionize commercial communication. Only a few years later both anesthesia and telegraphy were to prove their humanitarian usefulness in the tragic War between the States. The year 1846, too, was the time of two other important American inventions: the sewing machine of Elias Howe and the rotary printing press of Richard Marsh Hoe.

These were remarkably spectacular discoveries, changing the trend of men's lives and occupations, setting their eyes toward new horizons There were also other important but less sensational scientific events taking place. John James Audubon, the indefatigable ornithologist and artist, had just completed and seen through the press his last great work, "The Viviparous Quadrupeds of North America," in collaboration with his friend the Rev. John Bachman. In Boston there arrived from Switzerland in 1846 the learned Louis Agassiz, who became America's most popular scientist and most memorable teacher

[1] This article, here published in commemoration of the 150th anniversary of the birth of Joseph Henry, will form a chapter in the author's book on the history of the Smithsonian Institution to be published by Henry Schuman, Inc., New York, in the Life of Science Library. Received August 20, 1947.

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and who wielded an influence in the natural sciences that was not to pass for several generations. Exploration was receiving great impetus. The United States Exploring Expedition, under the command of Capt. Charles Wilkes, had returned in 1842 after four years in the South Seas and Antarctic regions with great things to tell. It had brought back large collections of zoological and geological specimens from many parts of the world, and these were to furnish scientific stimuli for many years. The expeditions of John C. Frémont, already mentioned, to the Rocky Mountains and beyond, were also fruitful. The intrepid Frémont, with a handful of picked men, explored the South Pass to California, and defined the geography, botany, geology, astronomy, and meteorology of that region.

Such were the men and events that set the stage for Joseph Henry, the first Secretary and "architect" of the Smithsonian Institution.

"Joseph Henry," wrote the astronomer Simon Newcomb, "was the first American after Franklin to reach high eminence as an original investigator in physical science." Though only 49 years old when chosen to head the Smithsonian, he had already made his reputation as a physicist through his great discoveries in electromagnetism, and at that time he was perhaps America's most distinguished scientist. This choice proved to be an incredibly wise one, when it is considered how frequently unwise appointments of public officials are made. The Smithsonian Board of Regents, however, had set their mark high. They wanted, they resolved, a man possessing weight of character as well as a high grade of talent. He must possess "eminent scientific and general requirements." He must be capable of "advancing science and promoting letters by original research and effort, well qualified to act as a respected channel of communication between the Institution and scientific and literary individuals and societies in this and foreign countries." Furthermore, he must have efficiency as an executive officer and a knowledge of the world. Henry was their man.

When the call came for him to take over the direction of the newborn institution, Henry was serving as professor of natural philosophy in the College of New Jersey (now Princeton University). He had been at Princeton since the fall of 1832, and here he was happily situated, since he was able to carry on his researches which he had begun while associated with the Albany Academy. Furthermore, he enjoyed teaching, was well liked at Princeton, and had little reason for desiring a change.

Descended from Scotch Puritans who had settled in eastern New York State about the time of the American Revolution, Joseph Henry grew up around Albany, N. Y., where he was born on December 17, 1797. That same year Franz Schubert was born in Vienna and Heinrich Heine in Düsseldorf. Although Henry was to become so eminent a scientist, his first leanings were not toward science at all, but toward literature.[2] Early in life he developed a fondness for the theatre and might well have become a distinguished actor. As a youngster he seemed not particularly studious, and for a

[2] Mary A. Henry, in her unpublished Diary [in the Smithsonian Archives] covering the years 1858 to 1868, recounts an amusing anecdote of her father that shows him to have been a boy possessing normal juvenile ambitions but with perhaps an unusual degree of inventiveness. On May 26, 1865, Miss Henry wrote: "At night Father gave us a little incident of his boyhood which interested us. He said that a certain man in the village where he lived with his grandmother—it was a shoemaker I believe—annoyed him greatly by passing his hand roughly over his face, bending up his nose in the process and causing him considerable pain. He was a slight, delicate boy but determined to discover some means of self-defence. He at length hit upon the following expedient—his first experiment as he says in practical mechanics. At the approach of his tormentor he threw himself upon the ground and as the man stooped over him to seize him he caught hold of [his] ankles and placing his feet in his stomach with one dexterous kick sent him over backwards. He tried the same experiment several times upon some young men who were in the habit of teasing him, and greatly to the amusement and admiration of the bystanders. He mentioned during the conversation that his first ambition was to be a chimney sweeper. He had watched a certain individual somewhat his senior ascend his grandmother's chimney and was inspired with the greatest admiration for the calling. There was a small space between his grandmother's house and that of the next neighbor and his clothes suffered greatly in consequence of his efforts to [crawl] between the two walls chimney-sweep fashion."

while was apprenticed to a watchmaker to supplement the family's meager income. When he was about 16, however, his attention was accidentally directed to a book containing "Lectures on Experimental Philosophy, Astronomy, and Chemistry, Intended Chiefly for the Use of Young People," by an English clergyman, the Rev. George Gregory. His interest was so seriously and strongly aroused that he determined to make the pursuit of these matters of "natural philosophy" the great object of his life. He began to study, first at a night school and then at the Albany Academy, earning his way by teaching a country school and later tutoring to the family of Gen. Stephen Van Rensselaer, of patroon fame. Next he participated in a road-surveying expedition across the central part of New York from West Point to Lake Erie, gaining some valuable experience and fortifying his somewhat precarious health. When he returned he was engaged as a teacher at Albany Academy, and in 1828, at the age of 31, he was appointed professor of mathematics. In May 1830 he was married to his cousin Harriet L. Alexander, of Schenectady. Two years later he was called to Princeton.

The next ten years were fruitful ones—both for Joseph Henry and for American science. In addition to his courses and lectures in physics and mathematics, chemistry, mineralogy, and geology, he was able to conduct his own experiments that were to prove epochal. Let us summarize briefly Henry's scientific researches up to the time that he went to Washington. Conveniently, such a summary is provided by Henry himself in a letter dated December 4, 1876, and addressed to the Rev. S. B. Dod. He divides his account into 16 parts, which are here somewhat condensed but given essentially in Henry's own phrasing:

1. Previous to leaving Albany, he says, he made a series of experiments on electromagnetism in which he developed the principles of the electromagnet and applied the magnetic power produced in the invention of the first electromagnetic machine; that is, a mechanical contrivance by which electromagnetism was applied as a motive power. Also, while in Albany, he applied the results of his experiments to the first electromagnetic telegraph, in which signals were transmitted by exciting an electromagnet at a distance, whereby bells were struck in succession.

At Princeton he continued his experiments and constructed a still more powerful electromagnet—one that would lift over 3,000 pounds—and with it illustrated to his students how, by means of a relay-magnet, a large amount of such power might be called into operation at a distance of many miles.

Just before leaving on a trip to England in 1837 he again turned his attention to the telegraph. The first actual line of telegraph using the earth as a conductor, he says, was made in the beginning of 1836. A wire was stretched across the front campus of the college grounds, from the upper story of the library to the hall opposite, the ends terminating in two wells. Through this wire signals were sent from his house to his laboratory. [Here Henry interpolates a short account of the history of the invention of the telegraph, claiming that the electromagnetic telegraph was first invented by him in Albany in 1830, two years, he says, before Morse conceived the idea and seven years before he attempted to carry his idea into practice, and stating that the reason he did not take out a patent on his invention, as he was urged to do, was that he did not consider it compatible with the dignity of science to confine the benefits that might be derived from it to the exclusive use of any individual. He reiterates that he was the first to bring the electromagnet into the condition necessary to its use in telegraphy and to point out its application to the telegraph. He gives Morse great credit, however, for his alphabet and for his perseverance in bringing the telegraph into practical use. The fact remains, however, that Morse was issued a patent for the invention of the telegraph on June 20, 1840. Just how much credit is due Joseph Henry will perhaps never be fully settled.]

2. His next experiment concerned what he called "electrodynamic induction." In 1831 Michael Faraday had discovered that when a current of electricity was passed

through a wire from a battery, a current in an opposite direction was induced in a wire arranged parallel to this conductor. Henry discovered that induction of a similar kind took place in the primary conducting wire itself, so that although a current in passing through a short wire conductor would produce no sparks or shocks, if the wire were long enough both of these effects would be produced. By using as a conductor a flat ribbon, covered with silk, rolled into a spiral form, he found that brilliant sparks and other electrical effects of high intensity could be produced from a battery of low intensity.

3. Afterward he made a series of investigations that resulted in producing inductive currents of different orders, of different directions, and made up of waves alternately in opposite directions. He found also that a metal plate of any kind, placed between two conductors, neutralized this induction, and that this effect was due to a current in the plate itself. He found that a current of quantity was capable of producing a current of intensity, and vice versa.

4. He also demonstrated that electrodynamic induction with ordinary electricity could be produced at a remarkable distance. If a current were sent through a wire on the outside of a building, electrical effects were produced in a parallel wire inside the building. He found also that the induced current appeared to change its direction with the distance of the two wires and that the discharge of electricity from a Leyden jar is of an oscillatory character.

5. His next experiments related to "atmospheric induction," reminiscent of Benjamin Franklin's experiment in drawing lightning from the clouds. In this he used two large kites, the lower end of the string of one being attached to the upper surface of the other, the end of the whole being coiled around an insulated drum, the "string" consisting of fine wire. When the sky was perfectly clear the kites were flown, and sparks were drawn, said Henry, of "surprising intensity and pungency, the electricity being supplied from the air, and the intensity being attributed to the induction of the long wire on itself."

6. A related experiment was made on induction from thunder clouds. Using his tin roof as an induction plate, he soldered a wire to the edge of the roof, passed it into his study and out again through holes in the window sash, and fastened the other end to a metal plate in a deep well in front of his house. By breaking the circuit of that part of the wire in the study and inserting in the opening a magnetized spiral, needles placed in this were magnetized by a flash of lightning so far away that the thunder could scarcely be heard. He found also that the electrical disturbance thus produced was oscillatory in character—the discharge first passing through the wire from the roof to the well, then another in the opposite direction, and so on until equilibrium was restored.

7. This experiment led to a series of experiments with lightning rods which contributed greatly to our understanding of the nature of electricity. It was shown, among other phenomena, that when a powerful electrical charge such as lightning is transmitted through a portion of air, the air along the path of the discharge is "endowed for a moment with an intense repulsive energy. . . . It is to this repulsive energy, or tendency in air to expand at right angles to the path of a stroke of lightning, that the mechanical effects which accompany the latter are generally to be attributed."

8. Another series of Henry's investigations pertained to "the phosphorogenic emanation from the sun," in which he extended the list of known substances "which possess the capability of exhibiting phosphorescence" when exposed to electric discharge.

9. A new method of determining the velocity of projectiles was the subject of his next inquiry. The principle involved in this was "the instantaneous transmission of electrical action to determine the time of the passage of a ball between two screens, placed at a short distance from each other in the path of the projectile. . . . The observer is provided with a revolving cylinder moving by clock-work at a uniform rate, and of which the convex surface is divided into equal parts indicating a fractional part of a second. The passage of the ball through the screen breaks a galvanic circuit, the



JOSEPH HENRY (1797–1878), first Secretary of the Smithsonian Institution.

time of which is indicated on the revolving cylinder by the terminal spark produced in a wire surrounding a bundle of iron wires."

10. In collaboration with his brother-in-law, Stephen Alexander, Princeton professor of astronomy, Henry experimented to determine the relative heat of different parts of the sun's disk. It was shown that the sunspots radiated less heat than the adjacent parts and that all parts of the sun's surface did not radiate an equal amount of heat.

11. Another experiment was made with what was called a thermal telescope, which consisted of a long hollow cone of pasteboard, lined with silver leaf and painted outside with lampblack. The angle at the cone's apex was such as to cause all the parallel rays from a distant object entering the larger end to be reflected onto the end of a thermopile, which was connected with a galvanometer. When the axis of the conical reflector was directed toward a distant object of greater or less temperature than the surrounding bodies, such as a horse, the difference was immediately indicated by the needle of the galvanometer. When the instrument was directed toward the sky, to different clouds, and to the moon, various conclusions as to radiant heat could be drawn.

12. Further studies of radiant heat were made "to examine the nature of the fact mentioned by Count Rumford that balls of clay introduced into a fire under some conditions increase the heat given off into an apartment." He concluded that the "increase in the radiant heat, which would facilitate the roasting of an article before the fire, would be at the expense of the boiling of a liquid in a vessel suspended directly over the point of combustion."

13. In another investigation, pertaining to the diffusion of metals, he demonstrated that mercury could be siphoned up through a 3-foot piece of thick lead wire and proved that solid silver would dissolve in solid copper.

14. He investigated the constitution of matter with reference to its "liquidity" and "solidity," concluding that "rigidity differs from liquidity more in a polarity which prevents slipping of the molecules than in a difference of the attractive force with which the molecules are held together." Heating a liquid, he said, does not neutralize the attraction of the molecules but rather neutralizes the polarity of the molecules so as to give them "perfect freedom of motion around any imaginable axis." He explained that the reason that the tenacity or cohesion of pure water is greater than that of soap and water is that the mingling of the soap and water interferes with the perfect mobility of the molecules and diminishes the attraction.

15. He further investigated the cohesion of liquids, measuring the tenacity of soap-water films by placing on them pellets of cotton until they burst. It was concluded that the attractive force of the molecules of water for those of water (several hundred pounds per square inch) is approximately equal to that of the molecules of ice for those of ice. He explained why oil spreads over water by the fact that "the attraction of water for water is greater than that of oil for oil, while the attraction of the molecules of oil for each other is less than the attraction of the same molecules for water." These experiments in molecular physics were pioneering.

16. Finally, in his letter to the Reverend Mr. Dod, Henry described at some length his contribution to science in "the origin of mechanical power and the nature of the vital force." He defined and classified mechanical power as opposed to "vitality." Mechanical power, he said, is that which is capable of overcoming resistance, or that which is employed to do work; vitality is that mysterious principle which determines the form and arranges the atoms of organized matter. This "doctrine," as he termed it, was first presented in December 1844 to the American Philosophical Society.

This, then, was the stature of the man who came down from Princeton to head the Smithsonian Institution, a man at the very peak of a brilliant scientific career, with many fundamental discoveries to his credit. And we must always admire Henry for the high regard in which he held pure scientific research. To expand the boundaries of knowledge he believed to be his special forte, and he left to perhaps less imaginative and more enterprising men the task of

applying this new knowledge to the uses of mankind. He did not even take out patents on his discoveries that might have made him a fortune, and in some instances he failed to publish his studies promptly, with the result that he can not be given full credit for some of them; for example, honors for the discovery of electromagnetic induction he must share with Faraday.[3] His natural modesty in claiming priority deterred him. He was more interested in having the approval of his scientific equals than in the applause of the multitude. He saw clearly the value of abstract science and was eloquent in its defense. "He who loves truth for its own sake," he wrote, "feels that its highest claims are lowered and its moral influence marred by being continually summoned to the bar of immediate and palpable utility."

One of the first jobs confronting the new Smithsonian Secretary was to supervise the construction of a suitable building to be the home of the Institution. Congress already, in the Act of Establishment, had placed on the Board of Regents the responsibility for the choice of a site[4] and the erection of the building. It should be constructed of "plain and durable materials and structure, without unnecessary ornament, and of sufficient size, and with suitable rooms or halls for the reception and arrangement, upon a liberal scale, of objects of natural history, including a geological and mineralogical cabinet; also, a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms."

There was little delay in getting the building under way, and the cornerstone was laid on the first day of May 1847, with impressive ceremonies attended by a large procession that included President Polk and his Cabinet. Accounts of the occasion tell us that the same gavel was used as that employed by George Washington when he laid the first cornerstone of the United States Capitol. They do not tell us, however, exactly which stone is the cornerstone except to infer that it is on the south side of the building. Either by weathering off of the inscription or by subsequent landscaping and filling in around the building, this architectural detail has been lost to us. An address fitting to the occasion was made by the Chancellor of the Institution, Vice President George M. Dallas, in which he described the building to be. "Its exterior," he said, "will present a specimen of the style of architecture that prevailed some seven centuries ago, chiefly in Germany, Normandy, and southern Europe, which preceded the Gothic, and continues to recommend itself, for structures like this, to the most enlightened judgment. It is known as the Norman, or, more strictly speaking, the Lombard style. It harmonizes alike with the extent, the grave uses, and the massive strength of the edifice; it exacts a certain variety in the form of its parts; and it authorizes any additions that convenience may require, no matter how seemingly irregular they may be."

The building was the first of this Romanesque twelfth-century style ever to be erected in this country for non-ecclesiastical uses. The architect was James Renwick, Jr., of New York, who also designed Grace Church and St. Patrick's Cathedral in New York City. The stone for the building, a lilac-gray freestone, was quarried from the banks of the Chesapeake and Ohio Canal, near Seneca Creek, Maryland, and only 23

[3] Credit for the discovery of the electrical principle of self-induction is now generally conceded as belonging to Henry, and this was officially recognized by the International Congress of Electricians in 1893, when the name *henry* was given to the standard of inductive resistance.

[4] President Polk himself helped the Regents in the selection of the site, but the final decision apparently followed the recommendation of Regent William W. Seaton, mayor of Washington. Polk wrote in his diary: "At nine o'clock this morning [Wednesday, Sept. 9, 1846] . . . I rode out in my carriage to meet the regents of the Smithsonian Institute [sic] on the public grounds lying west of the Capitol and south of the President's House, with a view to locate the site of that institution. I met the regents on the ground, and spent nearly an hour with them on foot in examining the grounds. Opinions were freely expressed. The most elevated ground, and, as I think, the most eligible site, lies between 12th and 14th Streets containing about 32 acres. . . . Most of the regents expressed a preference for this location. Mr. W. W. Seaton . . . earnestly urged that the location should be made west [obviously he meant to say east] of 12th street and between that street and the Capitol. This is a lower situation than that west of it, and in no sense, as it strikes me, so eligible." The actual location—"upon the center of Tenth Street"—was determined on March 20, 1847, by a resolution of the building committee.

miles from the site. The length of the building from east to west measures 447 feet, and its greatest width is 160 feet. The building has nine towers of various shapes and ranging from 60 to 145 feet in height.

By April 1849, the east wing of the building was completed to the point where it could be occupied by the Secretary and his staff. Before the end of the year the west wing was finished. The entire building, interior and exterior, was not completed immediately, however, and some construction was still going on in 1857, although the main edifice seems to have been finished in December 1854.

On January 24, 1865, in spite of the fact that precautions had been taken to make the Smithsonian Building fireproof, a fire broke out in the main portion, destroying the roof, the interior of the upper story, and the interior of the two large north towers and the large south tower. Although the losses were not considered to be severe, many records, publications, and manuscripts were destroyed, as well as apparatus and a large stock of tools and instruments. Perhaps the most serious loss was the collection of the personal effects of James Smithson, including numerous manuscripts written by him. Another unfortunate loss was a valuable series of Indian portraits and scenes (in all about 150 canvases) which had been temporarily deposited by the artist, J. M. Stanley, in 1852; all but seven of these pictures were destroyed. The building was repaired at a cost of about $150,000.[5]

By the time of the fire, the Institution had been in operation nearly 20 years. During this period Professor Henry had successfully put into effect a plan of organization which was thereafter to guide its course.

Even before he left Princeton, Henry was requested by the Board of Regents to study the will of James Smithson and present a plan of organization, so that when he arrived in Washington he had already given considerable thought to the problem of what the proper functions of the Institution should be. He laid down a few basic principles on which he thought the organization should operate. One was that the Institution should undertake nothing that could be done adequately by other agencies of the country. Another was that the Smithson bequest was intended for the benefit of mankind, and that, therefore, "all unnecessary expenditure on local objects would be a perversion of the trust." The United States Government would act as trustee to carry out the will of Smithson. The Institution, however, would not be a national establishment in the usual sense, but rather the establishment of an individual, to bear and perpetuate his name. The objectives of the Institution were clear—first, to increase, and second, to diffuse, knowledge among men. Inasmuch as the will did not define or restrict in any way the particular kind of knowledge to be diffused and augmented, no branch of knowledge could rightly be excluded from its share of attention. Said Henry, "Smithson was well aware that knowledge should not be viewed as existing in isolated parts, but as a whole, each portion of which throws light on all the other, and that the tendency of all is to improve the human mind, and to give it new sources of power and enjoyment."

With these liberal principles in mind, Henry proposed that the Institution, in order to *increase knowledge*, should (1) stimulate men of talent to make original researches, by offering suitable rewards for memoirs containing new truths, these memoirs to be published in a series of quarto volumes called "Smithsonian Contributions to Knowledge"; and (2) appropriate annually a portion of the income for particular researches, under the direction of suitable persons. To *diffuse knowledge* he proposed (1) to publish a series of periodical

[5] One account of the fire says: "A series of cases intended for ethnological specimens had been constructed in the gallery on the second floor, which made it necessary to rearrange the Indian paintings. The day was extremely cold, and with a view to their comfort in hanging the pictures the workmen brought a stove into the room and inadequately inserted the pipe in a ventilating flue which opened under the roof. The conflagration which ensued burnt out the entire upper story of the main building, as well as the central main towers on both the north and south sides. . . . The contents of the upper gallery were almost entirely destroyed. These . . . consisted mainly of the Indian paintings of J. M. Stanley, Charles B. King and others, probably other paintings, and the marble copy of the Dying Gladiator."

reports on the progress of the different branches of knowledge; and (2) to publish occasionally separate treatises on subjects of general interest. At the meeting of the Board of Regents on December 8, 1847, Henry presented the details of this general plan for the Board's consideration and approval. Furthermore, the plan was submitted to a number of literary and scientific societies, and it must have been gratifying to the new Secretary to have his work widely approved. "In every case," he reported, the program "received their unqualified approbation."

On December 13 the plan was officially adopted. The stage was now set. The work of, as well as an edifice for, the Smithsonian Institution could now start.

As a matter of fact, it had already started. In May 1847, Professor Henry had received a letter from two archeologists of Chillicothe, Ohio—E. George Squier, A.M., and E. H. Davis, M.D.—who had been investigating the ancient Mound Builders of the Mississippi Valley region. They had prepared an elaborate manuscript based on a study of over 200 of the Indian mounds, comprising, they said, the results of extensive original surveys and explorations, and they wished to submit it for publication by the Smithsonian Institution. This, it appeared, promised to be what Henry was looking for to start the new series "Smithsonian Contributions to Knowledge." He received the manuscript and, after submitting it for critical examination to several competent scholars, accepted it for publication. It was published on December 1, 1848, under the title "Ancient Monuments of the Mississippi Valley," illustrated by 48 lithograph plates and 207 wood engravings. Uncopyrighted, a copy was sent to every principal library of the world, though the edition was small. It was the first scientific publication to be issued by the Institution.

It should be remembered that in 1848 there were very few outlets for the publication of such monographs as that by Squier and Davis. The American Philosophical Society at Philadelphia and the American Academy of Arts and Sciences at Boston issued publications, and there was an increasing number of scientific journals springing up, many of them organs of scientific societies. But for the most part authors had to pay for the publication of their work, especially if it was anything as pretentious and costly as "Ancient Monuments of the Mississippi Valley." Learned societies then did not have much money to spend on quarto volumes and expensive illustrations. It can be readily appreciated what this new Smithsonian publication plan meant to the scientists of America. They now had a new and dignified medium for the publication of their researches and could be assured of world-wide distribution of their papers. Henry knew, though he had himself been dilatory in the prompt publication of some of his own electromagnetic discoveries, that science is valueless unless given to the world to be put to whatever use the human race desires or is capable of. Said Henry, "The real workingmen in the line of original research hail this part of the plan as a new era in the history of American science."

The Contributions soon became widely known among scholars, and in the ensuing years many important monographs appeared in the series. The only requirement was that each paper should constitute a positive addition to knowledge based on original research. The series ran for 68 years, being discontinued in 1916. A few of the well-known papers in this series are: "Memoir on Mechanical Flight," by Langley and Manly; Coffin's "The Winds of the Globe"; Shaler's "Comparison of Earth and Moon"; Morely's "On the Densities of Oxygen and Hydrogen, and the Ratio of Their Atomic Weights" and Morgan's "Systems of Consanguinity and Affinity of the Human Family."

The original act of Congress establishing the Smithsonian made specific provision for a library, and it was therefore incumbent upon the new Secretary to begin its formation at once. On January 26, 1847, Charles Coffin Jewett, a young professor of modern languages and literature at Brown University, was appointed Assistant Secretary of the Institution to serve as librarian. The initial purpose of the library was to procure "a complete collection of the memoirs and

transactions of learned societies throughout the world and an entire series of the most important scientific and literary periodicals," and it was agreed that a special library of this kind could be a means both of increasing and diffusing knowledge. Professor Jewett was an energetic man with ideas and was far in advance of his time in library planning and technique. He became recognized as one of the most active librarians and bibliographers of his day, and under his direction the Smithsonian collection grew, in six years, to 32,000 volumes. It was fast becoming, under his tutelage, a national reference and bibliographic center. One of Jewett's original ideas was a plan whereby, instead of the expensive printing of catalogues of American libraries, separate stereotyped titles would be made available to librarians. In this way a general catalogue of the public libraries of the United States could be constructed. This was a genuine contribution to library science and was later developed by the Library of Congress.

Jewett performed fine work in laying the foundation for the Smithsonian Library. If anything, however, he was overambitious in plans for the future in view of the Institution's limited funds, which had to be spread over an increasing variety of activities. Jewett felt that he should spend on the library all that the law allowed. In 1855 a difference of opinion arose between Henry and Jewett over the library administration and authority, chiefly over the matter of expenditures and as to whether the library should be developed along predominantly scientific or literary lines. Science and Henry prevailed, and Professor Jewett was retired from office after eight years' service. Thereafter he became Superintendent of the Boston Public Library and there rendered notable service for a number of years.

This library question, to be sure, was an animated one; and Jewett's release started a Congressional investigation and caused the resignation of the Hon. Rufus Choate from the Board of Regents. In general, however, Secretary Henry's policy was upheld, namely, that the library should not be developed at the expense of the other activities of the organization. The indorsement of the Secretary's policy by Congress definitely cleared up the question as to whether the creation of a great library should be one of the Institution's main objects. Henry felt strongly that the Smithsonian should not engage in any way in competition with other organizations and that although a modest library of scientific literature was needed for the use of its own staff, it was not the function of the Smithsonian to build up a large national library in competition with the Library of Congress and other institutions. Rather, let the Smithsonian Library work in cooperation with other libraries, but avoid needless duplication of functions and materials.

An example of this duplication was the matter of copyright. For nearly 13 years after the founding of the Institution, it was required by law that anyone wishing to secure copyright of a book must deposit one copy with the librarian of the Smithsonian Institution and another copy with the librarian of Congress. This dual requirement, it seemed to Henry, was unnecessary and promised to be a burdensome one; and in 1857 he succeeded in having section 10 of the original Smithsonian Act of 1846 repealed, and the Library of Congress became the sole copyright depository.

A few years later, in 1866, another "merger" was effected, when the Smithsonian Library by Congressional authority turned over to the Library of Congress about 40,000 volumes of scientific works, to form the basis of what has since been known as the "Smithsonian Deposit." "The object of this transfer," wrote Henry, "is not, of course, to separate this unique and highly prized collection of books from its relations to the Smithsonian Institution, for it must still bear its name and be subject to its control, but merely to deposit it where its preservation will be more certain [thinking probably of the fire in the Smithsonian Building] and its usefulness more extended." In the eighty-odd years that have passed since the original "Smithsonian Deposit," almost a million volumes and parts have been added to it, to make it one of the largest collections of scientific literature in the world. It is especially com-

plete in the transactions and proceedings of scientific societies.

The removal of these books not only relieved the space problem in the Smithsonian Building but also eased the financial strain by putting upon the shoulders of Congress the responsibility for the upkeep of this collection. Furthermore, it was in harmony with Joseph Henry's general policy of trying to keep the organization of the Institution from becoming too cumbersome and from outgrowing its income. Besides a library, the Smithsonian Act had directed that a museum, an art gallery, and courses of lectures should be under the aegis of the Smithsonian. Henry, however, though not openly opposed to these, believed that they should be projects only temporarily undertaken by the Institution, to be turned over to other agencies when possible. In this way, he felt, the Smithsonian could concentrate its activities on matters of benefit to all mankind rather than on those of local and restricted interest.

So far as the museum was concerned, however, this was destined to remain under the direction of the Smithsonian and to grow into a large and important organization supported by Government funds. Like the library, the museum flourished inordinately, until in 1866 it was stated that the collections, "taken as a whole, constitute the largest and best series of the minerals, fossils, rocks, animals, and plants of the entire continent of North America, in the world." Of the large North American and European mammals it had the best collection in the United States; of birds, its collection ranked second only to that of the Academy of Natural Sciences of Philadelphia; and of fishes only Louis Agassiz had a larger collection. So, even though Secretary Henry would like to have seen the museum subordinated or even divorced from the Institution, Congress ruled otherwise, and the museum continued to develop and occupied generous quarters in the new building. On July 5, 1850, Spencer Fullerton Baird, biologist, was made Assistant Secretary of the Institution to take charge of the museum and to aid in the publication program. Baird as Assistant Secretary, and later as Secretary, was destined to play a signal role in the development of the museum and in the affairs of the Institution.

Another principle laid down by Joseph Henry that guided the Smithsonian's course of action from the very beginning was cooperation. He early realized that if the Institution was to fulfill its high purposes it must extend its activities and influence beyond that directly covered by its limited income. To do this meant to fit into the scientific life of America in the give-and-take spirit. It was well enough to spend large sums in aid of research and in publishing and distributing Contributions to Knowledge by scientific investigators who had no other channel by which to make known the results of their researches, but it was necessary also for other institutions and individuals in turn to contribute to the work of the Smithsonian. Something of this kind was absolutely necessary, for the Smithsonian simply did not have the funds or the staff to carry on all the activities it was called upon to perform. In return, it would lend its prestige, publish results, and correlate.

In his second annual report (for the year 1848) Henry outlined a project that was to furnish a notable example of this cooperation. It was an experiment in the science of meteorology. His plan was to obtain weather reports from a great network of voluntary observers scattered over the country. He was especially interested in assembling long-range data on climate and weather from stations in every region, and in this way furnishing a sound foundation upon which the science of meteorology could build. We know today how far this science has advanced, how much we depend on weather forecasts and the daily weather report. We remember what an important part meteorology played in World War II. But in Henry's day it was new; Henry was a pioneer, and he and the Smithsonian must have credit for initiating the work that finally culminated in the United States Weather Bureau.

After persuading the Regents of the Institution to support his project, he went ahead. There would be, he said, three classes of observers: "One class, without

instruments, to observe the face of the sky as to its clearness, the extent of cloud, the direction and force of wind, the beginning and end of rain, snow, etc. A second class, furnished with thermometers, who besides making the observations above mentioned, will record variations of temperature. The third class, furnished with full sets of instruments, to observe all the elements at present deemed important in the science of meteorology."

This proved to be a cooperative enterprise of the highest degree. First there were the individual voluntary observers distributed over the entire continent, and by 1852 these numbered about 200, reporting directly to the Smithsonian. Then the States of New York and Massachusetts cooperated by setting up weather stations with instruments at various academies; these had State support but were directed by the Institution. Further observations were made at a hundred or so military posts of the United States, under the direction of the Surgeon General of the Army. Separate series of observations were made by exploring and surveying parties and reported back to the Institution. In Canada, or British America as it was then called, observations were made at the various posts of the Hudson's Bay Company. Stations reached to Nova Scotia, Panama, and Bermuda, and there was one observer at Ascención, Paraguay. The work had the active support of such eminent meteorologists as Arnold Guyot, James P. Espy, Elias Loomis, James H. Coffin, and William Ferrell. Professor Guyot, the Swiss scientist who had just come to the United States, was entrusted with the selecting and ordering of the improved instruments required and with the job of preparing a set of "Directions for Meteorological Observations" to serve as a guide for the observers.

Another paragraph in Henry's second annual report was epoch-making. "As a part of the system of meteorology," he said, "it is proposed to employ, as far as our funds permit, the magnetic telegraph in the investigation of atmospheric phenomena. By this means, not only notice of the approach of a storm may be given to distant observers, but also attention may be directed to particular phenomena, which can only be properly studied by the simultaneous observations of persons widely separated from each other. For example, the several phases presented by a thunderstorm, or by the aurora borealis, may be telegraphed to a distance, and the synchronous appearances compared and recorded in stations far removed from each other. Also, by the same means, a single observatory . . . may give notice to all persons along the telegraph lines, of the occurrence of interesting phenomena. . . ." Knowledge of an approaching storm, he thought, could be of great advantage to agriculture and commerce, and this, he concluded, "is a subject deserving the attention of the general government."

Henry, then, must be given credit for first utilizing the electric telegraph in this way, although it may have been suggested by others. As Cleveland Abbe wrote in 1871 in the *American Journal of Science*. "The Smithsonian Institution first in the world organized a comprehensive system of telegraphic meteorology." By 1857, there was a series of weather reports coming in via the National Telegraph line from New Orleans to New York and as far west as Cincinnati. The *Washington Evening Star* was the very first newspaper to publish them. Naturally they exited much interest and were soon extended farther north and westward. The next year a daily weather map, compiled from telegraphic reports received at 10 o'clock every morning, was exhibited in the Smithsonian Building.

All this combined in a practical way the telegraph and the work of the weather observers throughout the country. The fast-accumulating weather data were soon put, however, to strictly scientific uses. Voluminous reports, maps, tables, and charts were prepared and published on all phases of the work—rainfall, snowfall, temperatures, barometric pressure, storms, meteors, auroras, etc. Between 1852 and 1884 four editions of "A Collection of Meteorological Tables" (later expanded into the Smithsonian Meteorological Tables), compiled by professor Guyot, were issued; and there were many more important scientific fruits of the

work. Although the Civil War, and also the disastrous Smithsonian fire, interrupted the work in many ways, it did not end the cooperative spirit that the enterprise seemed to engender. In 1864 the North American Telegraphic Association, covering the entire United States and Canada, gave the free use of all its lines for the scientific objects of the Institution. In the meantime, however, there began agitation in favor of "a meteorological department under one comprehensive system with an adequate appropriation of funds." Henry, too, was in favor of such a plan, and in 1869 Congress passed a resolution establishing the Weather Bureau of the United States Signal Service. Consequently, the Smithsonian's great system of meteorological reports was turned over to the new bureau. Few new agencies of the Federal Government have ever had so generous a birthright and so solid a foundation. It represents perhaps the greatest experiment in cooperation that the Smithsonian ever attempted, but its unqualified success was an inspiration and pattern for many less pretentious undertakings.

Always uppermost in Joseph Henry's mind was the great purpose that James Smithson prescribed for his Institution—the "increase and diffusion of knowledge among men." This must outweigh all other considerations, and it became the Institution's motto.[6] "The worth and importance of the Institution," wrote Henry in 1852, "are not to be estimated by what it accumulates within the walls of its building, but by what it sends forth to the world."

Henry was referring here not only to the distribution of the Institution's own publications but also to another effective scheme of diffusing knowledge that had been inaugurated in 1849 designed to facilitate the distribution and exchange of literary and scientific publications between this and other countries. It was a happy idea, and today after a hundred years it is still one of the continuing functions of the Smithsonian, although the financial support of the Exchange Service has long since (1881) been shouldered by Congressional appropriations. Henry left much of the organization of the Exchange Service to Assistant Secretary Baird and put him in charge of it. This is how the plan originated:

With the appearance in 1848 of its first publication, "Ancient Monuments of the Mississippi Valley," the Institution was confronted with a problem of how best to distribute copies where they would be the most useful and accessible. In addition to the American distribution, a few hundred copies were sent to scientific and other learned institutions abroad, with the request that they exchange publications. At first the number of responses to the proposal was small, but by 1852 Professor Henry reported that 4,744 articles were received. To continue this desirable exchange of intelligence with other nations, Henry appointed agents in a number of foreign countries. Especially cooperative was the Royal Society of London. Gradually the system expanded until Henry was able to offer other learned societies of the United States the facilities set up at the Institution in distributing their publications abroad. The Exchange Service became a clearing house for the receipt and distribution of scientific literature. Incoming packages of exchange publications were admitted free of duty and were allowed to pass the customs without the delay of an examination. Many of the great transportation companies and steamship lines extended to the Exchange Service the privilege of free freight.

From the beginning the United States Government departments made use of the Exchange Service in obtaining official documents of other governments in exchange for their own. In 1867 Congress passed an act systematizing this governmental interchange, but it was not until 1881 that any Congressional financial support was given the system. By that time the Exchange Service was costing so much, in spite of generous free freight and other concessions, that something had to be done, and Congress assumed part of its support by appropriating $3,000. This support was con-

[6] The seal of the Smithsonian Institution adopted in 1847 carried a left-facing likeness of the founder, James Smithson. The new seal, designed by Augustus St. Gaudens and adopted in 1893, carries the words "For the increase and diffusion of knowledge among men—*per orbem.*"

tinued and increased, until just before World War II the annual appropriation for the Service reached approximately $50,000.

For about 40 years the International Exchanges operated unofficially, so to speak, from the standpoint of international law. Beginning in 1875 international conferences were held in Paris and Brussels, which discussed the exchange between countries not only of governmental documents but also of scientific and literary publications, and in 1886 a formal agreement was reached. Eight nations ratified the convention—"International Exchange of Official Documents, Scientific and Literary Publications"—and it was officially proclaimed by the President of the United States on January 15, 1889. Other nations "came in" later, and with those countries that did not ratify special arrangements were made for exchanges. The Smithsonian Institution was recognized as the official exchange agency of the United States.

Briefly, this is how the Exchange System, inaugurated by Joseph Henry, works at the present time: Libraries, scientific societies, educational institutions, and individuals in this country who wish to distribute their publications abroad as gifts or exchanges send the separate addressed packages to the Smithsonian Instititution, carriage cost prepaid. There they are sorted by countries and forwarded with similar shipments from other organizations to the exchange agencies in other parts of the world, where they are distributed to the addressees. Similarly, shipments of publications from exchange agencies abroad to the Smithsonian are distributed free to addressees in the United States.

The Smithsonian International Exchange Service—originating, as we have seen, in Professor Henry's efforts to distribute Smithsonian publications most effectively—has now been in operation for a full century, with but two major interruptions, these occasioned by World Wars I and II. Even throughout the years of World War II exchanges were continued with all countries of the Western Hemisphere and with a few in other parts of the world. The Exchange Service has demonstrated itself as a very tangible expression of the Smithsonian Institution's part in "the diffusion of knowledge." It, again, is an instance of that cooperative kind of enterprise envisioned by Joseph Henry as the most effective means for the Smithsonian to fulfill its destiny.

There was still another means of "diffusing knowledge," especially among the residents of the National Capital, that was initiated as soon as the new Smithsonian Building became available. This was a series of free lectures. Professor Henry never was in full favor of these lectures for he felt that, being local, they were "too limited in their influence to meet a proper interpretation of the will of Smithson." However, they had been ordered by Congress, and Henry could not do otherwise than to provide them. He sought to maintain the lectures on a high plane, "to improve the public taste rather than to elicit popular applause." The lecturers, many of whom were invited from a distance, were paid for their services in accordance with the modest appropriations made for the purpose, but it is evident in noting some of their names that Professor Henry was able to obtain the best to be had.

It was—the mid-nineteenth century—the heyday of the popular lecture. Long before the days of the radio and motion-picture and other modern forms of mass entertainment, the average man seemed hungry for knowledge and willing to put forth effort to improve his education, and a series of a dozen lectures on geology, astronomy, history, or literature would be taken in stride. Every city of any size had its lecture courses (this was before the days of the Chautauqua when every village also had them), usually sponsored by the intellectual associations, such as the Lowell Institute of Boston, the Athenaeum of Richmond, and the Cooper Union of New York; and in many cases the lecturer's remuneration was liberal enough to attract men of reputation. The great Emerson traveled a lyceum circuit that took him as far west as St. Louis and Milwaukee. Dr. Oliver Wendell Holmes went as far as Cincinnati and Louisville. "Public lectures," wrote Henry in the report for 1852, "have become one of the characteristics of the day, and

next to the press tend, more than any other means of diffusing knowledge, to impress the public mind."

The Smithsonian lectures were given chiefly while Congress was in session. The first lectures under the auspices of the Institution were a series delivered, beginning on February 25, 1847, in Washington's Odd Fellows Hall, by William Scoresby, the English Arctic explorer, on "The Construction and Use of the Rosse Telescope." The next ones were a course of four on "Modern Athens" delivered by Professor Koeppen of Denmark in Carusi's Hall, beginning on April 6, 1849. A course of six on "Geology" followed, beginning on April 30, 1849, by Dr. Edward Hitchcock, president of Amherst College—the first to be given in the Smithsonian Building. As facilities improved the program was expanded; in 1850, during the last session of Congress, lecturers appeared and delivered one to several lectures apiece, ranging from a single lecture on "Holland," by the Rev. Dr. George W. Bethune, to a course on "The Unity of the Plan of the Animal Creation," by Prof. Louis Agassiz, of Cambridge, Mass. "Whatever may have been the effect of these lectures in the way of diffusing knowledge," commented Henry, "it is evident, from the character of the men by whom they were delivered, that they presented truths intended to elevate and improve the moral and intellectual condition of the hearers." In the roster of lecturers for the next few years we find such names as Dr. Benjamin Silliman, of Yale College; Prof. Benjamin Silliman, Jr.; Pres. Mark Hopkins, of Williams College; Dr. B. A. Gould, Jr., of Cambridge; Prof. Louis Agassiz, who in 1863 became a Regent of the Institution; Prof. Stephen Alexander, of the College of New Jersey; Prof. A. Guyot; and Hon. Henry Barnard, educational reformer. As the years went by, however, the lecture phase began to wane somewhat, no doubt aided by Henry's reservations as to the Smithsonian's proper interest in such lectures, valuable as they might be. Today, except for an occasional one, usually by a member of the staff, and the annual Arthur Lecture on some phase of solar research, the "Smithsonian lecture" is but a memory. In late years the lingering lecture needs of the general populace of the City of Washington seem to have been supplied chiefly by the National Geographic Society in its popular winter series. The lecture was an influential phase of American life that is largely past, and it is probable that modern educational and entertainment methods have permanently supplanted it. But it was good while it lasted, and the Smithsonian played an active and dignified part in the half century or so of its greatest popularity. The Lecture Room in the Smithsonian Building was entirely burned out by the fire of 1865, and it was never reconstructed as such.

Professor Henry's own researches during this period suffered by reason of his administrative duties, but by no means did his scientific work entirely cease, and his contributions to science at Washington were numerous. He was active in support of the American Association for the Advancement of Science, which in 1848 he had helped to organize. During the Civil War he was a trusted friend of President Lincoln and was called upon many times for advice in scientific matters. He assisted Lincoln in planning the National Academy of Sciences and was one of its original members. In 1864 he wrote, "A large share of my time has been devoted for the last four years to investigations required by the public exigencies." This part played by Henry and the Institution in the Civil War and the services he rendered to the various Executive Departments in scientific matters can never fully be told, however, as the official records and correspondence were lost in the fire. While serving on the U. S. Lighthouse Board, of which he was made chairman in 1871, Henry conducted a series of experiments that led to the substitution of lard oil for sperm oil for use in the extensive system of lighthouse beacons, before kerosene became an abundant fuel. This, it has been estimated, saved the Government as much as $100,000 a year. Based on his studies of the laws of sound, he also devised a siren fog-signaling system, which was later adopted by the Government.

In 1854 he conducted a series of experiments on the strength of different kinds of

building stones offered for the extension of the United States Capitol. He experimented in the field of acoustics. He constructed a large sulphuric-acid barometer, which was in successful use for many years, and had its readings constantly recorded. Other important experiments of Henry's might be mentioned to show the variety of his interests and abilities. Yet he was so scrupulous that he allowed none of his own researches to be published by the Institution. As one account puts it, "Many of his most valuable papers must be searched for in unsuggestive volumes of Agricultural or Light-House Board Reports."

Busy as he was with Smithsonian affairs, he somehow found time for all these activities. He was called upon to make many public addresses; and his position required that he keep in close contact with scientific men and work throughout the country. In 1868 he was chosen President of the National Academy of Sciences and held that position until his death. Meetings of the Academy were held in the Smithsonian Building. In 1871 he was active in organizing the Philosophical Society of Washington and served as its president as long as he lived. In 1870 the Board of Regents granted him a leave of absence (plus expenses) that he might take a trip to Europe "for the interests of the Institution in the promotion of science . . . and to consult with savants and societies of Great Britain and the continent." This trip proved to be a most profitable one, one of his accomplishments being to testify before an English Government Scientific Commission regarding the methods and aims of the Institution. After an absence of four and a half months he returned much improved in health and with impressions as to science and education in the Old World that were to prove of value to him in directing the affairs of the Institution.

Visitors to the Smithsonian today are sometimes told that in the early days some members of the staff resided in the Smithsonian Building. Professor Henry and his family lived in the east wing for 23 years—from 1855 until his death. The Henrys were a family of the old school, close-knit, loyal, and devoted to one another, deriving their greatest pleasure in each other's company. There were four children—the three daughters, Mary, Caroline, and Helen, and the son, William Alexander Henry, who died in 1862 in early manhood. Two others had died in infancy. The family's residence in the Smithsonian Building spanned the entire period of the Civil War. From here they watched the Confederate flag flying over Alexandria six miles away; saw the regiments passing through the city; followed the daily news of battles; looked upon the prisoners and the wounded being brought in; waited for news of peace; lived anxiously through the sad event of Lincoln's assassination; wondered, even with the Union saved, what was to happen to the nation. Through it all their home was a bright spot. It was more than a home. It was a center of intellectual life in Washington; and always welcome were visiting scientists, professors, writers, lecturers, officers, and other distinguished men who came to the city. Some of the cheerful fireplaces of the Henrys' living quarters are still in use in the east-wing executive offices in the Smithsonian Building—impressing one now as a rather refreshing anachronism among the modern Government office buildings on Washington's Mall.

Joseph Henry had been reared in the stern atmosphere of Scotch Presbyterianism. He was a practicing Christian and brought up his family accordingly. His science never destroyed his religious faith, nor did he ever see any basic conflict between science and religion. With Lincoln, the family attended the New York Avenue Presbyterian Church, and they were active in church affairs.

In December 1877 Henry was stricken with nephritis and died the following May 13, in his eighty-first year. In his death American science lost its most distinguished leader and the Smithsonian Institution its great "architect" and chief. He was buried in Oak Hill Cemetery in Georgetown, D. C. Tributes and eulogies were paid him by statesmen and scientists, memorial services were held in the United States Capitol, and a bronze statue was erected to his memory on the grounds of the Smithsonian.

John Quincy Adams said of the Smith-

sonian, "Of all the foundations or establishments for pious or charitable uses which ever signalized the spirit of the age or the comprehensive beneficence of the founder, none can be named more deserving the approbation of mankind." Joseph Henry, more than any other person, made that statement true, and that is his eternal monument. On May 17, 1878, four days after Henry's death, Assistant Secretary Spencer Fullerton Baird, of Carlisle, Pa., was elected the new Secretary.

BOTANY.—*A revision of* Chorisepalum, *an endemic genus of Venezuelan Gentianaceae.*[1] JOSEPH EWAN, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering.

First discovered on Mount Duida, Venezuela, in November 1928, and up to the year 1944 known only from the single original species, *Chorisepalum* is known today to be a genus of four remarkably distinct species living on the table mountains or *cerros* of Venezuela, including Roraima. The original species, *Chorisepalum ovatum* Gleason, was described from the unicate collection, *G. H. H. Tate* 462, as a straggling shrub 8 feet tall, with large green tubular flowers, growing at the "bottom of slope of Ridge 25" on the summit of Mount Duida, at 5,200 feet elevation. It has not been re-collected. No illustration accompanied the original publication of the monotypic genus and since no duplicates were available for distribution it remained a nearly forgotten genus. When, therefore, I received for naming an excellent series of Gentianaceae from Dr. Julian A. Steyermark, of the Chicago Natural History Museum, I was first quite puzzled by the three collections here described as three new species of *Chorisepalum*. I had indeed designated them as species of a probable new genus when I became aware that I had bypassed the publication of the new genus established in 1931 by Gleason and Wodehouse in the account of the Tyler-Duida Expedition although I had consulted that report repeatedly. Thereupon my suspicion that what I had earmarked as a new genus would prove to be *Chorisepalum* was borne out at once when I examined the type of *C. ovatum* kindly lent by the New York Botanical Garden. It seems appropriate,therefore, to bring together at this time all our present information on the genus, with illustrations, since the genus has not heretofore been illustrated in botanical literature.

[1] Received May 14, 1947.

It is real pleasure to take this opportunity to thank Dr. J. A. Steyermark for his kindness in entrusting this material to me for study, along with the entire series of his Ecuadorian and Venezuelan Gentianaceae. Seldom, indeed, have botanists been able to work with such well-prepared material in such quantity, accompanied by such full field notes as has been possible from Steyermark's most recent South American explorations. As one who has had an introduction to plant collecting in the American tropics, I can especially appreciate his accomplishments and I congratulate him.

In the citation of specimens the following abbreviations are employed: *F*, Chicago Natural History Museum, Chicago, Ill.; *US*, U.S. National Herbarium, Washington, D. C.; and *USNA*, U. S. National Arboretum Herbarium, Bureau of Plant Industry Station, Beltsville, Md.

GENERIC RELATIONSHIPS

At the time Gleason and Wodehouse described the genus *Chorisepalum* they suggested its affinities with *Zygostigma* in its separate sepals, and with *Rusbyanthus*, in the completely 2-celled ovary, believing the latter to be its nearest relative. In my opinion *Chorisepalum* is most closely related through *C. psychotrioides* and *C. rotundifolium* to *Macrocarpaea*, especially with *M. calophylla* of the Sierra Nevada de Santa Marta of Colombia. Indeed, *Macrocarpaea calophylla*, material of which has not been available to me for study, may prove to be a species of *Chorisepalum*. Gilg described the calyx-lobes of *Macrocarpaea*

calophylla as being distinct nearly to the base, the fundamental character of *Chorisepalum*. Gleason and Wodehouse considered *Macrocarpaea* as a possible relative of *Chorisepalum*, but decided against such a relationship since *Macrocarpaea* generally has a "prominent calyx-tube with usually short and rounded lobes," and an invariably 1-celled ovary. Moreover, no species of that genus of Andean shrubs have aristate petals.

Wodehouse provided a detailed description of the pollen-grains of *Chorisepalum ovatum* at the time the genus was first described, and gave a line drawing of a grain. No affinity with other genera of the family was suggested for *Chorisepalum* on the basis of its pollen-grain morphology.

Finally it may be said that certainly the deeply divided calyx in *Chorisepalum* (cf. Fig. 1,B) sets the genus apart taxonomically from other American Gentianaceae, yet even so fundamental a character as chorisepaly vs. gamosepaly must be considered along with other morphological characters and not alone, lest undue emphasis be attached to it. It is possible, however, that chorisepaly in this genus is indicative of primitiveness among the Gentianaceae. The geographic distribution of these four species, occupying as they do geologically old land masses in South America, is perhaps pertinent in this connection.

TAXONOMY

Chorisepalum Gleason & Wodehouse, Bull. Torrey Bot. Club **58**: 452. 1931.

Simple-stemmed shrubs or subshrubs, now erect and recalling *Psychotria*, now recalling a liana with long decumbent or pendent stems, these terete or quadrangular, often nodose, leafy up to the inflorescence; leaves varying from short-ovate or lance-ovate to orbicular, entire, plane or sometimes a little undulate, now thick and with only the midrib evident, now thinner and with the veins evident on the upper surface when raised beneath, always more or less firm-coriaceous, acute or less often obtuse, all petiolate; flowers single and terminal or 3–5 in a terminal and at times dichasial cyme, green or greenish, evidently rather early withering but somewhat marcescent; calyx tending to be ovoid, the lobes distinct to the base, lance-acuminate, or narrowly oblong, obtuse, acute or contracted to a subulate tip, subequal or two calyx-lobes somewhat longer than the other three; corolla tubular or narrow-campanulate, $1\frac{1}{8}$–$1\frac{3}{4}$ times as long as the calyx, the lobes 5 (or "actually 6"), elliptic, aristate or less often rounded; stamens attached near the base of the corolla-tube and slightly exceeding it; anthers linear; ovary linear, completely 2-celled by the intrusion of the placentae; style slender, equaling the stamens; stigma bifid, its lobes narrowly elliptic; capsule splitting into 3–5 nearly distinct cartilaginous portions, each more or less spreading in age and tending to separate, rather long-persistent on the shrub. Type species: *C. ovatum* Gleason.

KEY TO THE SPECIES

Flowers solitary and terminal, large (6–7 cm long), more or less showy; leaves smooth above, the midrib evident beneath, the secondaries obscure on both surfaces.
- Calyx-lobes obtuse; corolla-lobes erect; stems nodose, more or less quadrilateral; leaves acute.....1. *C. ovatum*
- Calyx-lobes contracted to acuminate tips; corolla-lobes reflexed; stems not at all nodose, terete; leaves obtuse or barely acute.....2. *C. carnosum*

Flowers several, in cymes, smaller (2–3 cm long), not at all showy; leaves impressed-nerved above, both midrib and secondaries raised beneath.
- Corolla-lobes rounded; calyx 22–24 mm long; leaves ovate.....3. *C. psychotrioides*
- Corolla-lobes aristate; calyx 16–20 mm long; leaves orbicular.....4. *C. rotundifolium*

1. **Chorisepalum ovatum** Gleason, Bull. Torrey Bot. Club **58**: 452. 1931.

Straggling shrub about 3 m high; leaves oval, 4.5–7 cm long, 3–4 cm wide, abruptly narrowed to a small triangular obtuse apex, rounded at the base, the midrib impressed above, elevated beneath, the lateral veins obscure; flowers large, tubular, green; calyx-lobes narrowly oblong, obtuse, 30 mm long; corolla-tube 40 mm long, its lobes 25 mm long, 15 mm wide, acute and aristate, the arista 5 mm long; filaments slender 30 mm long, inserted 15 mm above the base of the corolla-tube; anthers 7 mm long; style slender, 30 mm long, the lobes of the stigma obtuse, 5 mm long; ovary narrowly linear, 12 mm long; mature fruit unknown.

Type collected at the "base of the slope of Ridge 25, 5200 feet," Cerro Duida, Venezuela,

November 26–December 16, 1928, by *G. H. H. Tate* 462 (type, NY; photo of type, USNA). The type bore but a single flower, which was removed and placed in a vial but the vial has not been located. The type sheet carries a drawing of the flower, laid open.

Chorisepalum ovatum is most closely related to *C. carnosum* of Carrao-tepuí, the two species occurring at comparable elevations on the two cerros. *Chorisepalum ovatum* has much thinner leaves than *C. carnosum*, recalling those of *Gardenia* or *Citrus*. But most striking are the very apparent differences in habit between the two species, *Chorisepalum ovatum*, as scantily known from the single sheet, having slender coarsely fissured branchlets with short internodes, *C. carnosum*, on the other hand, having elongated, almost smooth cordlike branchlets with the internodes about as long as the leaf-blades. Both species are more or less "straggling shrubs" but evidently *Chorisepalum carnosum* is much more of a climber than *C. ovatum*.

2. **Chorisepalum carnosum** Ewan, sp. nov. Fig. 1, A

Semiclimber or subepiphyte, the stems single, erect, 2–3.5 m high, scandent or nearly so, finely fissured, glabrous throughout; leaves oval, thick-coriaceous and subsucculent, narrowly revolute-margined, only the midrib evident, dark green above, pale green beneath, 5–7.5 cm long, 4.0–4.5 cm wide, barely acute or rounded, all short-petiolate, the petioles stout, 7–10 mm long; flowers solitary and terminal, large, showy, with a slight odor of musk; calyx campanulate, 5 cm long, narrowed to an acute base, the lobes triangular-lanceolate, cuspidate; corolla about $1\frac{1}{2}$ times as long as the calyx, 6.5 cm long, the lobes "dull green" on back, "dull greenish" within, reflexed, the tube "bronze-lavender" within; capsule oblong-ovate, ca. 2.5 cm long, deflexed in age.

Suffrutex subscandens vel subepiphyticus 2–3.5 m altus caulibus erectis vel scandentibus procumbentisve, totis glabris et fissuratis; foliis omnibus breviter petiolatis, petiolis firmis 7–10 mm longis, laminis foliorum superiorum paulum reductis, omnibus ovalibus, vix acutis vel saepe obtusis, crasso-coriaceis et subsuculentis, margine anguste revolutis, supra lucidis saturate viridibus, subtus pallidioribus, venis secondariis utrinque obscuris, 5–7.5 cm longis, 4.0–4.5 cm latis; floribus solitariis et terminalibus, magnis et speciosis; calyce campanulato, 5 cm longo ad basim acutem contracto, lobis triangulari-lanceolatis, cuspidatis; corolla 6.5 cm longa, tubo intus pallide aeneo-purpurascenti, lobis utrimque opaco-viridibus, retroflexis; capsula oblongo-ovata, ca. 2.5 cm longa, post maturitatem deflexa.

Type collected on the southeastern portion of the base of Carrao-tepuí, altitude 1,460–1,615 meters, State of Bolívar, Venezuela, December 4–5, 1944, by *Julian A. Steyermark* 60852 (type, F; photo of type, USNA; isotype, US).

Chorisepalum carnosum is very evidently most closely related to *C. ovatum* of Mount Duida; both plants known from a single collection but amply distinct. Together they comprise a most striking species-pair, comparable to the situation in some other endemic genera of the Venezuelan cerros.

The thick-coriaceous leaves of *Chorisepalum carnosum* recall to some persons certain species of the genus *Clusia* and to others the genus *Hoya*. In any event, the leaves are highly diagnostic among the tropical American Gentianaceae and the characters are at once evident from the photograph (Fig. 1, A). The flower of the type specimen chosen for the illustration was mistakenly mounted with the shoot on the left, although it is evident from the point of attachment of the pedicel that it belonged on the shoot mounted on the right. Indeed, *Chorisepalum carnosum* and *C. ovatum* are almost unique among species of the lisianthoid genera of the New World in having a solitary terminal flower.

Steyermark remarks on the label that the species "was seen above 'Misia Kathy' camp [on the mesa between Ptari-tepuí and Sororopán-tepuí] as a dominant ground cover or understory, but at that time was seen only sterile and not collected."

3. **Chorisepalum psychotrioides** Ewan, sp. nov. Fig. 1, B, C.

Simple-stemmed shrub or subshrub 2.5–4 m high, glabrous throughout, a little glandular about the uppermost nodes, the upper internodes short, the branchlets evidently leafy; leaves ovate, mostly abruptly acute or again barely acute at tips, acute to cuneate at the base, "subcoriaceous-chartaceous," impressed-nerved and dull olive-green above and more



FIG. 1.—Two species groups of *Chorisepalum:* A, *C. carnosum* (type, *Steyermark* 60852), with single terminal flower (see text), and C, *C. psychotrioides* (type, *Steyermark* 58668), with cymes; B, same, inflorescence enlarged, showing the chorisepalous calyces.

yellowish beneath, the veins percurrent and anastomosing along the margin, prominently raised, 8–14 cm long, 5–6 cm wide, the petioles rather stout, 1–2 cm long; flowers 2–5 in terminal and dichasial cymes, the pedicels strongly flattened; calyx ovoid, 22–24 mm long, the sepals lance-acuminate, hyaline-margined below, the tips long, acicular, involute; corolla after anthesis a little longer than the calyx, evidently green when fresh, the lobes rounded; capsule oblong, the body 15 mm long, the beak 8 mm long, the fruit persistent after dehiscence.

Frutex vel suffrutez 2.5–4 m altus, caulibus simplicibus, totis glabris, supra paulo glandularibus foliosis, internodiis superioris brevibus; foliis ovatis, saepe apice breviter acutis vel vix acutis, basi acutis vel cuneatis, subcoriaceo-chartaceis, opaco-olivaceis, subtus subflavis, supra impresso-nervis, venis percurrentibus et ad marginem anastomosantibus, subtus prominentibus, 8–14 cm longis, 5–6 cm latis, petiolis crassis, 1–2 cm longis; floribus 2–5, terminalibus et cymosis, pedicellis valde compressis; calyce ovoideo, 22–24 mm longo, lobis lanceolato-acuminatis, ad basim hyalino-marginatis, apice longo, aciculari involuto; corolla post anthesin paulo longiore quam calyce, viridi (?), lobis obtusis; capsula oblonga, persistenti, 15 mm longa rostro 8 mm longo excepto.

Type collected in forested southwest-facing quebrada near Rondón Camp, Mount Roraima, State of Bolívar, Venezuela, alt. 2,040 meters elevation, September 25, 1944, by *Julian A. Steyermark* 58668 (F no. 1183945; photo, USNA).

Another collection:

Venezuela: Bolívar: Ptari-tepuí, forested sandstone south-facing slopes between plateau portion and "Cave Camp," 1,700–1,800 meters, *Steyermark* 59707 (F.).

Chorisepalum psychotrioides resembles *C. rotundifolium* most closely of the known species. From the latter it may be distinguished by the non-punctate leaves (cf. Fig. 1, B) as well as by their ovate, not orbicular, shape. On Ptari-tepuí, where both species occur, *Chorisepalum psychotrioides* occupies a lower altitudinal position than *C. rotundifolium*, with a hiatus of 200 meters between their areas. *Chorisepalum psychotrioides* is the only species known from Roraima.

4. **Chorisepalum rotundifolium** Ewan, sp.nov.

Shrub 1.5–3.0 m high, glabrous or subglabrous throughout, the upper internodes short, densely leafy up to the inflorescence; leaves orbicular, 3–6 cm long, the largest blades of sterile shoots short-ovate, rounded, much larger, 13 cm long, 8–10 cm wide, thick-coriaceous, impressed-nerved above, dull and punctate on both surfaces, sometimes a little puberulent beneath near the base, all short-petiolate, the petioles 2–8 mm long; flowers usually 3–5 in terminal cymes, also axillary in the uppermost axils, the pedicels terete; calyx narrowly ovoid, 16–20 mm long, the sepals lance-acuminate, scarcely if at all hyaline-margined below, the involute portion of calyx-lobes short; corolla much exceeding the calyx, green, the lobes narrowly lanceolate, about 1 cm long, acuminate to a hairlike tip; capsule oblong, the body 14 mm long, the beak (persistent style) 4 mm long.

Frutex 1.5–3 m altus, omnino glaber vel subglaber, internodiis superioribus brevibus, ad cymam dense foliosis; foliis orbicularibus, 3–6 cm longis vel laminis foliorum sterilium 13 cm longis et 8–10 latis, breviter ovatis, supra impresso-nervis, crasso-coriaceis, subtus paulo puberulentibus prope basim, utrinque opacis et punctatis, breviter petiolatis, petiolis 2–8 mm longis; floribus saepe 3–5, cymosis terminalibus et axillaribus, pedicellis teretibus; calyce anguste ovoideo, 16–20 mm longo, lobis lanceolato-acuminatis, basi vix hyalino-marginatis, apice involuto loborum brevi; corolla valde exserta, viridi, lobis anguste lanceolatis, ca. 1 cm longis, aristatis; capsula oblonga, 14 mm longa, rostro 4 mm longo excepto.

Type collected in *Bonnetia roraimae* forest on southwest-facing shoulder, Ptari-tepuí, State of Bolívar, Venezuela, altitude 2,000–2,200 meters, November 2, 1944, by *Julian A. Steyermark* 59730 (type, US; isotype, F).

Venezuela: Bolívar: Sororopán-tepuí, crest of cerro between east and west end, alt. 2,255 meters, Nov. 14, 1944, *Steyermark* 60139 (F).

Chorisepalum rotundifolium is certainly most closely related to *C. psychotrioides* of Roraima and Ptari-tepuí. In addition to the *differentiae* given in the key, the two species may be readily identified even in sterile condition by the punctate character of the leaves of *C. rotundifolium*.

ECONOMIC ENTOMOLOGY.—*The effect of particle size and velocity of movement of DDT aerosols in a wind tunnel on the mortality of mosquitoes.*[1] RANDALL LATTA, LAUREN D. ANDERSON, and E. E. ROGERS, U. S. Bureau of Entomology and Plant Quarantine, and V. K. LAMER, S. HOCHBERG, H. LAUTERBACH, and I. JOHNSON, Columbia University. (Communicated by C. F. W. MUESEBECK.)

This paper reports a continuation of the cooperative work between the Bureau of Entomology and Plant Quarantine and the Central Aerosol Laboratory of Columbia University on the influence of the size of uniform particle size oil aerosols of DDT upon mosquitoes. In the first paper[2] the mosquitoes and the aerosols were maintained in chambers so that an essentially static atmosphere prevailed. In the present paper this restriction is removed by subjecting the test insects to an aerosol moving in a wind tunnel at carefully defined speeds of motion.

It was recognized that aerosols applied in the open as large clouds, and drifted across an area to be treated, might be governed by somewhat different factors than were those applied in confined atmospheres. In the open, movement by drifting would far exceed gravitational fall. Furthermore, in drifting by wind movement, all particles could be assumed to have the same velocity regardless of size, within the range of sizes capable of remaining airborne for any length of time.

The apparatus for the generation of these homogeneous aerosols and the optical instruments and methods of measuring their particle size which had been developed by LaMer, Sinclair, Hochberg, and others in the Central Aerosol Laboratory in previous studies relating to various types of smokes were utilized in this study. A detailed description is given in O.S.R.D. Reports Nos. 119 and 1668, and N.D.R.C. Div. B Report No. 57.

In the previous work on confined atmospheres, exposures of 10 to 30 minutes in aerosol concentrations of around 100 micrograms per liter, of oil containing 8 percent of DDT were necessary to cause high mortalities when particles of 1 micron or less in diameter were used. On the other hand, exposures of $\frac{1}{2}$ to 2 minutes in aerosol concentrations of around 25 micrograms per liter produced high mortality when particles were 5 to 16 microns in diameter. When Ct (concentration $\times$ time of exposure) values which produced 50 per cent mortality of females were plotted against particle size, the toxicity was shown to be increased 250-fold when the diameter of the particle was increased from 0.33 to 11 microns. It was shown also that this curve corresponds to a curve in which the time necessary for an aerosol to settle out of 1 cc is plotted against particle size, as calculated according to Stokes's law. This finding indicated that the mortality of resting insects caused by aerosols in confined atmospheres resulted from deposition of the particles on the insects as a result of gravitational settling, and could be directly correlated with Stokes's law; i.e., the toxicity was proportional to the square of the diameter of the particle up to about 16 microns diameter, the concentration of DDT and the exposure time being held constant.

Shortly after the completion of the work on confined atmospheres, a theoretical treatment of the extent of deposition of wind-borne aerosols upon objects of various

[1] This work was conducted under transfers of funds, recommended (1) by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine, and (2) by the National Defense Research Committee, from the Office of Scientific Research and Development to Columbia University under Contract OEMsr 1388. It is based upon Report No. 5566 of the O.S.R.D. dated July 30, 1945. This report is on file with the Insect Control Committee of the National Research Council and is available for reference upon application to that agency. Received June 2, 1947.

[2] LAMER, V. K., S. HOCHBERG, et al. *The influence of the particle size of homogeneous insecticidal aerosols on the mortality of mosquitoes in confined atmospheres.* (In press.) This paper is based upon O.S.R.D. Report No. 4447, to which the reader is referred for more details of execution and of history of subject.

geometrical shapes by Winsche[3] based upon Sell's[4] original studies became available. This study indicated to us that the deposition upon insects, and hence the toxicity of a moving mass of aerosol, might likewise be expected to be dependent upon the square of the radius (or diameter) of the particle and in addition upon the first power of the velocity of the wind propelling the aerosol.

The series of experiments reported in this communication were therefore undertaken to test this conclusion by direct measurements in a wind tunnel. This study was performed at the Bureau laboratories, Agricultural Research Center, Beltsville, Md., between January 10 and May 2, 1945. The Central Aerosol Laboratory at Columbia University was responsible for all the physical and chemical phases of the program and the Bureau for all biological phases, as well as quarters and all permanent installations. Evaluation of results was done jointly.

[3] WINSCHE, WARREN E. *The deposition of nonvolatile aerosol clouds in open and forested areas.* N.D.R.C. Report No. 10.4–55. 1944.

[4] SELL, W. [*Spray precipitation in an uncombined body and in an air filter.*] Ver. Deutsche Ingen. Forschungsarb., V.D.I Verlag, 347. Berlin, 1931.

TECHNIQUE

Aerosols uniform in particle diameter were introduced into the mouth of a small wind tunnel (Fig. 1) in which a known air flow was maintained. Adult mosquitoes in cages were exposed in the tunnel to measured quantities of the aerosol and observed for mortality.

The wind tunnel was constructed of composition board and was 1 foot square in cross section by 32 feet in length. The air movement was provided by a suction blower attached to the end of the tunnel. The air flow was adjusted by a slide damper placed just ahead of the blower and measured by determining the pressure drop across an orifice placed in the tunnel ahead of the damper. The pressure drop was read by means of an inclined manometer. This arrangement allowed air flows ranging from 1 to 16 m.p.h. to be determined with accuracy. The calibrations of the velocity of air flow in respect to the

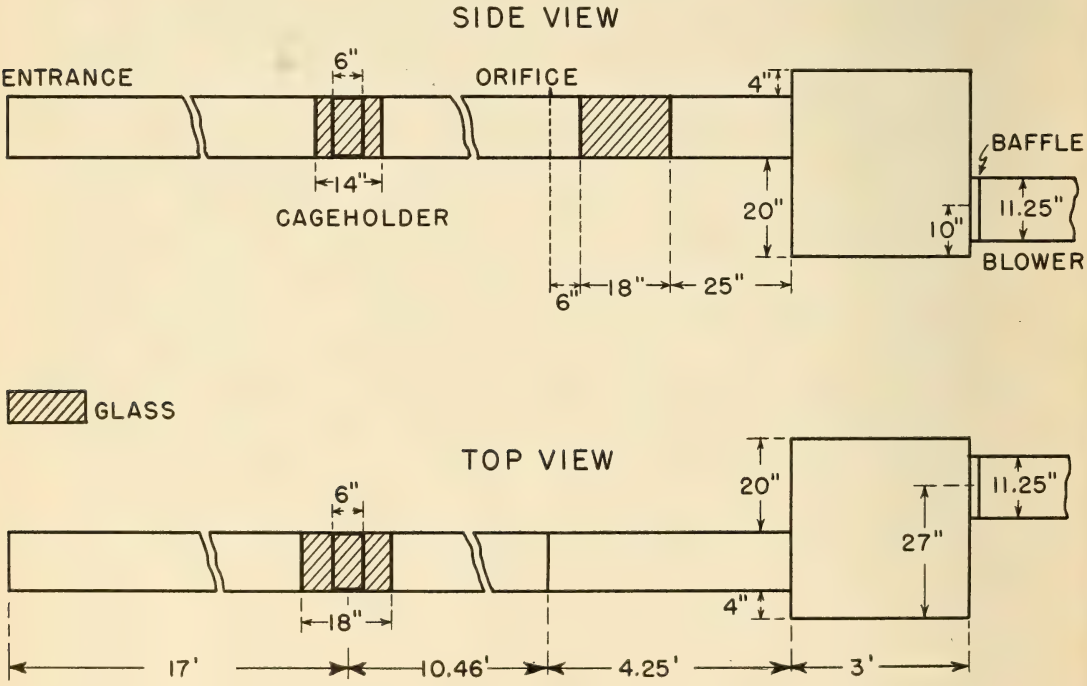


FIG. 1.—Diagram of wind tunnel used in these experiments.

radial distribution of flow in the tunnel, as well as adjustments of the orifice diameter and pressure, were performed by K. C. Hodges and J. C. Rowell, of the Central Aerosol Laboratory. Their findings, which proved to be in good agreement with the predictions of air flow theory, are fully discussed in O.S.R.D. Report No. 5566. This report should be consulted by those interested in the details of constructing wind tunnels.

At a point 17 feet from the mouth of the tunnel, a cage holder (Fig. 2) into which a

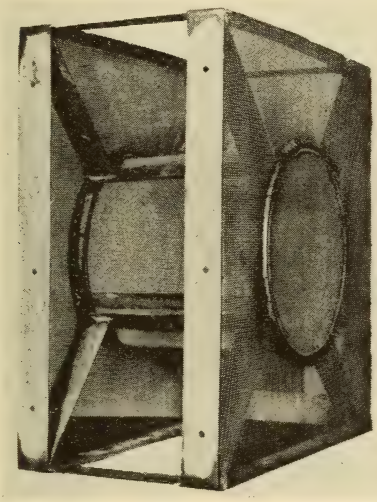


Fig. 2.—Square frame placed across the wind tunnel to hold the insect exposure cage in the exact center. The cage is in place.

cage holding mosquitoes could be inserted, was placed in the tunnel. The cages were cylindrical, 6 inches in diameter and 6 inches long, with both ends removable. The side walls of the cages were lined with 20-mesh wire cloth. The covers were made of 16-mesh wire cloth. The holder, which occupied the entire cross section of the tunnel, was covered front and back with 16-mesh wire cloth in order to equalize resistance across the tunnel. Glass windows were inserted on all sides of the tunnel at the location of the cage, so that observations could be made during treatment. Access to the tunnel was through a removable panel in the top.

The mouth of the tunnel was equipped with a flared metal collar and a mixing baffle. The distance from the mouth to the position of the cage was sufficient to allow the aerosol to be distributed uniformly across the tunnel. The uniformity of distribution of the aerosol in the cylindrical cage was confirmed by observing, through the windows, the flow of a screening smoke.

The aerosols were prepared in a LaMer-Sinclair homogeneous aerosol generator, similar to the one used in the previous studies relative to aerosols in confined atmospheres except for some modifications for preparing more homogeneous aerosols in the large particle range. In this generator DDT, dissolved in an oil having a narrow boiling-point range and a vapor pressure comparable to that of DDT, was vaporized in glass vessels, and mixed with known amounts of air and with a controllable number of nuclei. The diluted vapor was allowed to cool and condense upon these nuclei under carefully regulated conditions. The particle size was controlled by regulating the vapor pressure by adjusting the temperature and the number of nuclei. The nuclei were produced by heating sodium chloride deposited upon electrically heated nichrome wire.

Two methods were used to determine the average particle diameter of an aerosol, rate of settling and impingement on a waved slide. In the first method the average time for 10 particles to settle 0.5 cm in quiet air was determined, and the particle diameter calculated from this figure. In the second method a slide was waved in the aerosol stream at the mouth of the tunnel, and a sample of at least 200 particles measured. The average diameter of the particles was calculated on the basis that the probability that a particle in the aerosol will adhere to the slide is in proportion to the square of its diameter. The aerosols were uniform in size. Generally 90 percent of the mass would fall in a range ± 10 percent from the average.

The output of the generator was constant, once it was properly adjusted for a desired particle size. Prior to a series of treatments the aerosol was drawn through a weighed glass-wool filter for a measured period of about 10 minutes. The filter was reweighed and the amount of aerosol gen-

erated per minute computed. The aerosol deposited on the filter was analyzed for DDT content. The content of DDT in the aerosol was usually somewhat different from the content in the unvaporized oil, owing to an unavoidable slight difference in vapor pressure. Different dosages of aerosol could be applied by varying the time during which the aerosol was introduced into the tunnel. The rate of generation was usually between 5 and 15 mg of oil-DDT aerosol per minute. The generator was placed above the mouth of the tunnel, with the outlet in the center of the tunnel opening.

Adult *Aedes aegypti* mosquitoes[5] ranging 4 to 7 days old were used in all tests. The mosquitoes were kept in a small insectary well removed from the wind tunnel. For individual tests mosquitoes were transferred from stock cages into one of the cylindrical cages used in the wind tunnel. The test cage was then transported to the tunnel in a closed fibreboard box and immediately placed in position in the tunnel. At the end of the treatment the cage was transported back to the insectary in the same manner, and the mosquitoes were immediately emptied into a clean cage for observation of mortality. Adequate control samples were handled in the same manner as treated ones, except for exposure to the aerosol.

In each series one control sample was exposed to air flow in the tunnel for a period equal to or greater than the most rigorous exposure in the treated series. When there was no wind the mosquitoes flew about the cage, but once air flow was started through the tunnel there was little or no activity. At low velocities they tended to congregate on the front screen of the cage, but at 16 m.p.h. they were blown against the rear screen and held there by the air flow. The control experiments showed that mosquitoes were not injured by air speeds of 16 m.p.h.

Mortality counts were made the day following treatment. The mortality of males was invariably greater than that of females, but only data on female mortality were used in the final evaluation of the results.

Every precaution was taken to prevent contamination of the cages and the insectary with DDT. The test cages were washed with acetone, and the holding cages thoroughly scrubbed with water after each using.

RESULTS

Fifteen series of tests were made with homogeneous aerosols. The particle diameter of these aerosols ranged from 1.12 to 20.4 microns. Since the particle size and the rate of generation remained constant once the generator was properly adjusted, all tests with a given particle size were made as a group when possible. A group usually consisted of four exposures each at velocities of 2, 4, 8, and 16 m.p.h.

The mortality produced by each particle size is given in table 1. The amount of aerosol is in terms of the total amount admitted to the tunnel. Since it all passed the point where the cage of insects was exposed, it represents the amount per square foot, as the cross section of the tunnel was 1 square foot.

DISCUSSION

For each particle diameter a set of curves was drawn, one for each wind velocity, relating the percent mortality of females to the number of milligrams of aerosol passed through the tunnel. From each curve a figure for the amount of aerosol required to kill 50 percent of the females was obtained by interpolation. Since the DDT content was determined for each run, the amount of DDT for 50 percent mortality of females can be derived from these figures. Such data for 14 particle sizes are given in table 2.

The curves fall into three types. Small particles yield curves similar to Fig. 3, large particles curves similar to Fig. 4, and intermediate sizes curves similar to Fig. 5. In the first case the amount of aerosol required to pass through the tunnel to kill any given fraction of the females is inversely proportional to the wind velocity; in the second case it is independent of the wind velocity, and in the third case it is inversely proportional to the wind velocity for low

[5] The mosquitoes were supplied by Abby Casanges and associates in the Bureau of Entomology and Plant Quarantine.

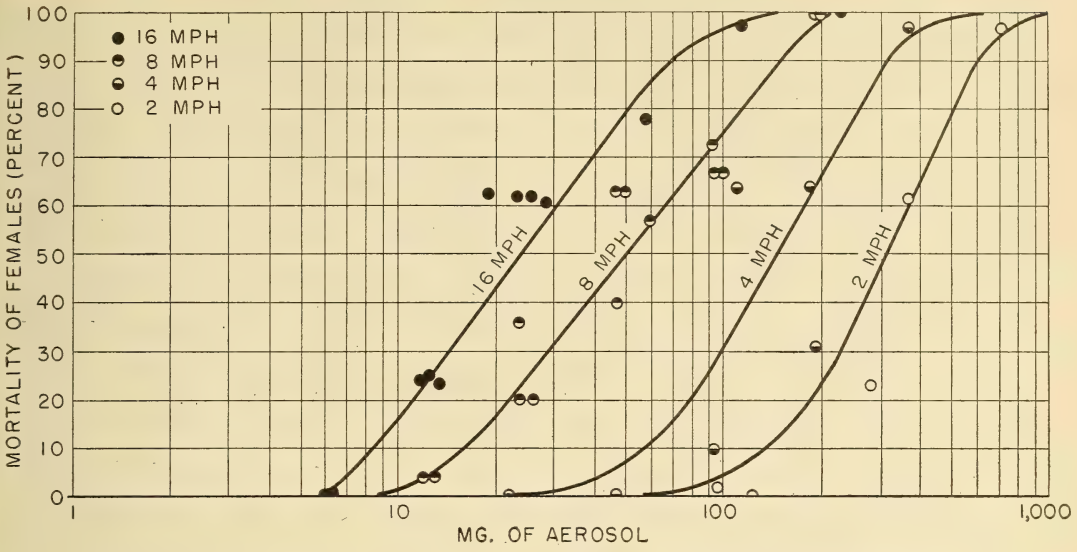


FIG. 3.—Dosage-mortality curves for a homogeneous aerosol of 2.5 microns particle diameter, moving at velocities of 2,4,8, and 16 m.p.h.

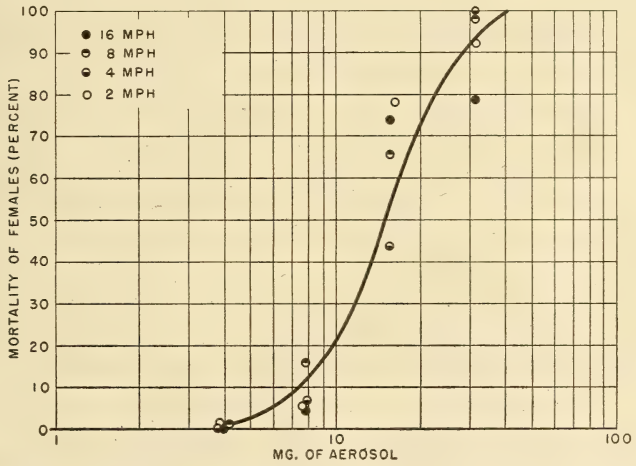


FIG. 4.—Dosage-mortality curve for a homogeneous aerosol of 20.4 microns particle diameter, moving at velocities of 2, 4, 8, and 16 m.p.h.

wind velocities and independent of wind velocity for high wind velocities.

The differences in mortality produced by aerosols with different particle size at a constant rate of motion, or by different rates of motion with an aerosol of constant size, were ascribed to differences in the rate of deposition of the particles on the insects induced by the above variations. In other words, the differences were due to a change in the percentage of particles which adhered to the insects in their paths, as a result of a change in size or velocity of the particle. It is easily observed that a reduction in particle size tends to reduce deposition. Smoke or fog, consisting of very fine particles, tends to follow the air streamlines around a body, and only a small fraction actually strikes the body. On the other hand, larger particles, as illustrated by rain, practically all strike bodies in their paths. It has been demonstrated also that an increase in the velocity of particles also increases the rate of deposition. In fact, it

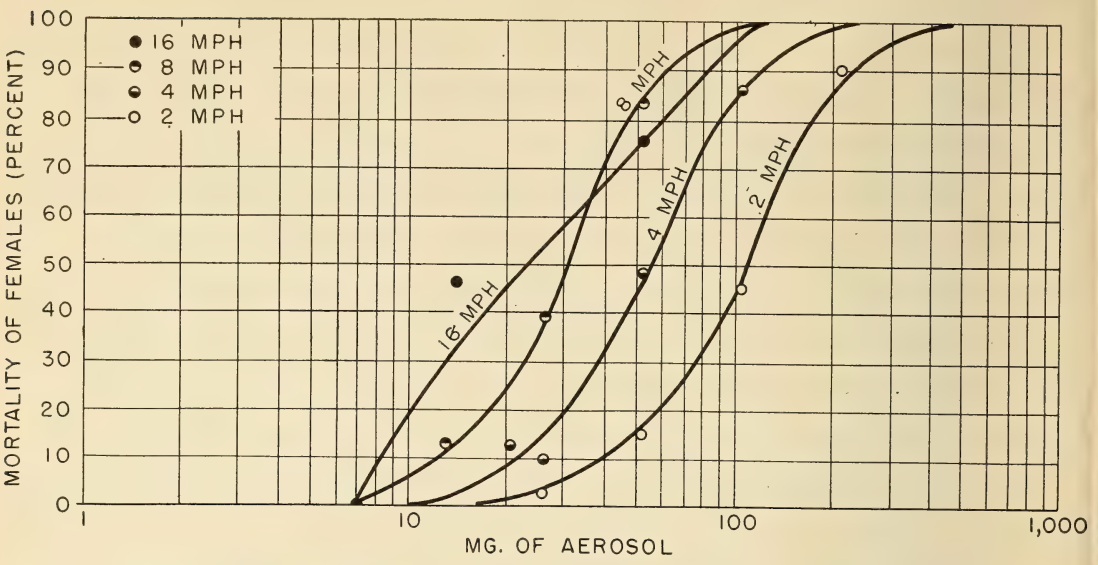


FIG. 5.—Dosage-mortality curves for a homogeneous aerosol of 5 microns particle diameter, moving at velocities of 2, 4, 8, and 16 m.p.h.

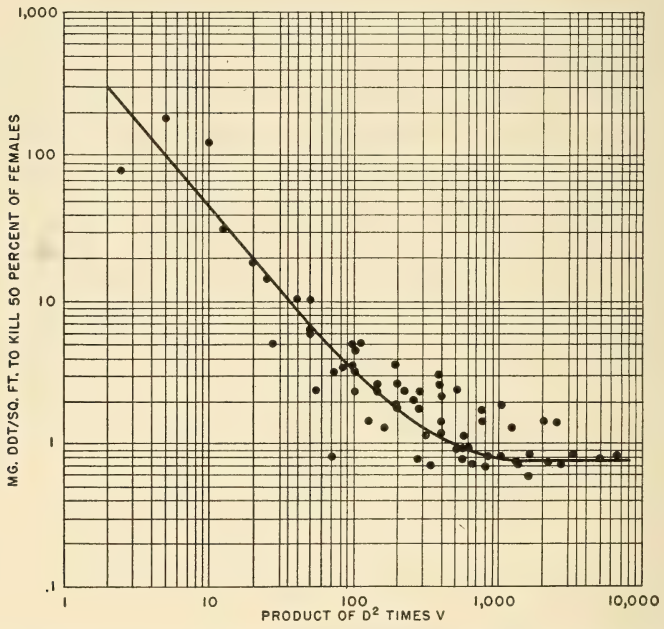


FIG. 6.—The effect of the product of D^2v on the amount of DDT required to produce 50 percent mortality of females.

is possible to remove practically all the particles of an aerosol by impingement against a surface with sufficient velocity.

In the range of the smaller particle sizes that were tested, the mortality with a given amount of DDT was dependent upon the particle size and velocity, i.e., proportional to the square of the diameter and the first power of the velocity. In the range of the largest particle sizes that were tested, the mortality with a given amount of DDT was not affected by a change in particle size or velocity. This condition was considered to be above the point where the maximum rate of deposition occurred. The influence of particle size and velocity upon

mortality decreased as the maximum rate of deposition was approached. In the range where particle size and velocity exerted their greatest effect on mortality, the amount of DDT required for 50 percent mortality was inversely proportional to the velocity; in other words, the rate of deposition was doubled when the velocity was doubled.

Since Winsche (1944) indicated that the deposition on an insect might be dependent upon the square of the diameter of the particle and the first power of the velocity, the amount of DDT in milligrams is plotted against the product of D^2v (D is measured in microns and v in miles per hour) for each particle size, in Fig. 6. At the lower values of D^2v, a single line plotted through these values has a slope of -1, which gradually changes to a slope of 0 at the higher values. This signifies that further changes in velocity or particle size do not affect the mortality.

After a certain value of D^2v is reached, the amount of insecticide required becomes independent of the velocity and diameter, but it is evident from statistical considerations[6] that eventually a point will be reached in particle size where a decrease in effectiveness will begin to occur. This is a consequence of the laws of probability, which come into prominence when a point is reached where a small number of particles are sufficient to kill an insect. When large numbers of particles are necessary each insect receives substantially the same number of particles and only the susceptibility of the insect determines the median lethal dose. On the other hand, when the particle number is small a small variation in number of particles represents a large percentage variation in toxic dosage. This effect, superimposed upon the susceptibility of the insect, tends to increase the median lethal dose.

Aside from the statistical considerations, it is evident that if a particle contains more than a lethal dose all the excess DDT in each particle is wasted. This factor will increase the apparent median lethal dose as determined experimentally and can become very significant.

[6] RODEBUSH, W. H. *Statistical considerations in the use of DDT aerosols.* O.S.R.D. Report No. 4757.

The optimum particle size for aerosols dispersed from the ground depends on at least two factors—(1) the most effective size in relation to deposit on the insect when the particle reaches it, and (2) the loss of aerosol by deposit on foliage and settling on its way to the insect. In these studies only the first factor was determined. However, certain known effects of particle size on the travel of aerosol clouds through vegetation permit an estimate to be made of the limits of particle size within which economical operation is feasible. If the aerosol cloud is to travel any distance at all, the particle size must be held down to one which will carry this distance. For maximum effect it must be held up to a size that will give the maximum rate of deposit on the insect. For *Aedes aegypti* the upper limits can be indicated by reference to Fig. 6. These limits would be at a point where D^2v is 300 to 1,000 (for example, 13 micron diameter at 5 m.p.h., or 10 micron diameter at 8 m.p.h., etc.). particles larger than this would not increase the efficiency of the aerosol when it reaches the insect, as a smaller percentage of such particles would carry to the insect.

Since the amount of DDT introduced into the tunnel was known, an approximate toxic dose of 0.03 microgram for a female of median susceptibility could be calculated from the data. For this purpose the area of a mosquito was assumed to be 0.03 cm^2, and the quantity of DDT to be 0.8 mg per square foot for large particles and high velocities where practically all particles would impinge on the insect. This quantity is contained in a single spherical particle of pure DDT (density 1.4) of a volume of 2.14×10^{-8} cm^3 or of a diameter of 34.4 microns. With a 10 percent solution of DDT, a 30×10^{-8} cm^3 droplet is required, which would be contained in a particle 83 microns in diameter.

The mortality curves obtained in these tests showed the amount of DDT causing 95 percent mortality to be between two and four times that for 50 percent mortality. Therefore, the approximate dose for 95 percent mortality would be between 6×10^{-5} and 12×10^{-5} mg; i.e., 0.06 to 0.12 microgram per insect. This would be a maximum amount, because in these cal-

culations the deposition of aerosol on the wire screen of the insect cage and the amounts deposited on the walls of the tunnel have not been considered. Neither of these quantities was measured. That deposited on the walls of the tunnel was minimized by the elimination of depressions and rough areas. It is estimated from Stokes's law that the error due to settling would be greatest with the largest particles and lowest wind velocities and would amount to less than 20 percent at 2 m.p.h. or less than 3 percent at 16 m.p.h. Deposition on the wire screen would be less than 35 percent, since the wires of the mesh occupy approximately 35 percent of the area of the screen.

The median lethal doses, as given in table 2, fall within a range of 0.5 to 2 times the central tendency as shown in Fig. 6. It is therefore considered that the total experimental error, including the variation in susceptibility of the mosquitoes from day to day, is within these limits.

CONCLUSIONS AND ANALYSIS

The following conclusions on the effect of particle size and the speed of motion were reached by comparing the mortalities produced by particles varying between 1.12 and 20.4 microns in diameter, under various speeds between 2 and 16 m.p.h. The first four conclusions are associated exclusively with physical factors, and would apply to any insect and any insecticide.

1. The rate of deposition of an aerosol upon an insect, as evidenced by the mortality, is affected by the particle diameter and the velocity.

2. Under conditions where only a small fraction of the particles deposit on insects in their path (small particles and low wind velocity), the amount of aerosol required is inversely proportional to the product of the square of the diameter and the wind velocity.

3. The increase in effectiveness with increase in particle size and velocity continues until practically all particles are deposited on an insect in their path. Thereafter, further increase in particle size or velocity is ineffective.

4. The mortalities caused by different velocities, or different particle sizes, depend on the product of the velocity and the square of the particle diameter. Doubling the particle diameter has the same effect on mortality as quadrupling the velocity.

5. Total deposition of the aerosol on *Aedes aegypti* females is approached when D^2v (D is measured in microns and v in miles per hour) exceeds 1,000. However, there is little difference in doses for D^2v values of 300 to 1,000. (For instance, where $D=1$ micron and $v=5$ m.p.h., $D^2v=5$ and incomplete deposition resulted. Where $D=25$ microns and $v=2$ m.p.h., $D^2v=1{,}250$ and practically complete deposition resulted, as evidenced by the mortality obtained.)

6. The approximate amount of DDT that should be deposited on an *Aedes aegypti* female of median susceptibility to cause mortality was determined to be 0.03 microgram. This quantity is contained in a droplet of 10 percent DDT solution 83 microns in diameter.

SUMMARY

In order to determine the influence of wind velocity and particle size on the toxicity of an oil aerosol bearing DDT to adult insects, cages of *Aedes aegypti* mosquitoes were exposed, in a wind tunnel, to aerosols of uniform and known particle size at wind speeds of 2, 4, 8, and 16 m.p.h. The diameter of the aerosol droplets ranged from 1.12 to 20.4 microns.

The quantity of DDT which must pass through a given cross-sectional area of the tunnel to kill 50 percent of the females is a simple function of D^2v, the product of the square of the diameter D of the droplets and the wind velocity. For small values of D^2v the quantity required is inversely proportional to D^2v; for large values it is independent of D^2v.

The results are analyzed on the basis that differences in mortality are produced by differences in rates of deposition of the aerosol, and on this basis a figure was obtained for the median lethal dose for females of 3×10^{-5} mg of DDT. This is contained in a single particle of a 10 percent solution 83 microns in diameter, or of 100 percent DDT 34 microns in diameter.

TABLE 1.—MORTALITY CAUSED BY PARTICLE SIZES OF AEROSOL RANGING IN DIAMETER FROM 1.12 TO 20.4 MICRONS, AT VELOCITIES OF 2, 4, 8, AND 16 M.P.H.

Particle diameter	Velocity	Total amount of aerosol	Content of DDT	Amount of DDT	Female mosquitoes	Mortality
Microns	*M.p.h.*	*Mg.*	*Percent*	*Mg.*	*Number*	*Percent*
1.12	16	48.2	11.55	5.6	24	8
		96.4	11.55	11.1	70	27
		114	10.42	11.9	64	8
		193	11.55	22.3	74	60
		223	12.4	27.6	72	92
		386	11.55	44.6	127	95
	8	193	11.55	22.3	12	0
		223	12.4	27.6	65	5
		386	11.55	44.6	103	9
		698	10.78	75.2	53	25
		750	10.42	78.2	121	19
	4	223	12.4	27.6	82	2
		386	11.55	44.6	117	2
		750	10.42	78.2	141	5
		771	11.55	89.0	10	10
		1308	10.78	141.0	56	39
	2	223	12.4	27.6	60	0
		386	11.55	44.6	55	11
		750	10.42	78.2	129	100
		771	11.25	86.7	60	60
		1308	10.78	141.0	52	100
	16	None	—	—	94	0
					81	0
					41	0
2.5	16	6.5	11.15	.72	62	0
		13	11.15	1.45	54	24
		14.6	12.55	1.83	73	25
		19.2	10.1	1.94	119	63
		26	11.15	2.9	47	62
		29.2	12.55	3.66	124	60
		58.4	12.55	7.33	110	78
		116.8	12.55	14.66	97	98
		233.2	12.55	29.27	75	100
	8	13	11.15	1.45	102	4
		23.2	9.25	2.15	33	36
		26	11.15	2.9	40	20
		46.4	9.25	4.29	79	41
		52	11.15	5.8	30	63
		60	10.1	6.06	53	57
		91.8	9.25	8.49	59	73
		104	11.15	11.60	54	67
		208	11.15	23.19	37	100
	4	23.2	9.25	2.15	107	0
		46.4	9.25	4.29	54	0
		91.8	9.25	8.49	115	10
		185.6	9.25	17.2	47	64
		192	10.1	19.39	58	31
		371.2	9.25	34.34	58	97
	2	96.0	10.1	9.7	62	2
		197.2	9.25	18.24	17	0
		288	10.1	29.09	52	31
		371.2	9.25	34.34	23	61
		720	10.1	72.72	91	97
	16	None	—	—	48	0
					111	0
					132	0
3.72	16	92.8	2.42	2.24	114	48
		185.6		4.49	42	86
		371.2		8.98	60	100
	8	185.6		4.49	75	44
		371.2		8.98	49	96
		742.4		17.96	84	100
	4	185.6		4.49	36	21
	2	371.2		8.98	20	5
4.48	16	4.78	9.17	.44	8	0
		9.55		.88	45	36
		19.1		1.75	62	79
		38.2		3.50	27	85
	8	9.55		.88	17	18
		19.1		1.75	99	68
		38.2		3.50	39	85
		76.4		7.0	140	93
	4	9.55		.88	31	3
		19.1		1.75	16	25
		38.2		3.50	48	52
		86.0		7.89	113	75
	2	19.1		1.75	16	0
		38.2		3.50	47	0
		76.4		7.0	92	24
		152.8		14.0	18	83
	16	None			68	0
					12	0
5.0	16	6.5	5.8	.38	53	0
		13		.75	124	46
		26		1.51	59	39
		52		3.02	24	75
	8	6.5		.38	49	0
		13		.75	76	13
		26		1.51	62	39
		52		3.02	29	83
	4	19.5		1.13	61	13
		26		1.51	61	10
		52		3.02	99	48
		104		6.03	29	86
	2	26		1.51	74	3
		52		3.02	52	15
		104		6.03	49	45
		208		12.1	29	90
		None	—	—	45	0
6.0	16	8	9.22	.74	23	39
		32		2.95	59	98
		64		5.9	29	100
	8	8		.74	53	4
		16		1.48	64	22
		32		2.95	104	71
		64		5.9	5	60

TABLE 1.—(*continued*)

Particle diameter	Velocity	Total amount of aerosol	Content of DDT	Amount of DDT	Female mosquitoes	Mortality
Microns	*M.p.h.*	*Mg.*	*Percent*	*Mg.*	*Number*	*Percent*
	4	8		.74	43	0
		16		1.48	35	29
		32		2.95	47	53
		64		5.9	7	71
	2	8		.74	47	0
		16		1.48	49	6
		32		2.95	31	48
		64		5.9	8	75
		None			33	0
7.0	16	8.1	7.64	.62	31	13
		16.2		1.24	47	43
		32.4		2.47	21	72
		64.8		4.95	38	79
	8	8.1		.62	58	0
		16.2		1.24	40	20
		32.4		2.47	56	50
		64.8		4.95	46	80
	4	8.1		.62	65	0
		16.2		1.24	57	12
		32.4		2.47	79	66
		64.8		4.95	25	72
	2	8.1		.62	72	0
		16.2		1.24	75	1
		32.4		2.47	58	29
		64.8		4.95	91	81
		None			87	0
7.1	16	.45	9.5	.04	30	0
		.91		.09	66	0
		1.81		.17	114	1
		3.63		.34	90	1
		7.26		.69	91	7
	8	.91		.09	41	0
		1.81		.17	31	0
		3.63		.34	88	0
		7.26		.69	93	9
		14.51		1.38	83	42
	4	3.63		.34	52	0
		7.26		.69	92	1
		14.51		1.38	102	54
		29.02		2.76	75	61
		58.04		5.51	77	78
	2	7.26		.69	30	0
		14.51		1.38	45	33
		29.02		2.76	196	62
		58.04		5.51	10	10
		116.08		11.03	141	87
		None			27	0
8.0	16	4.16	7.62	.32	84	0
		8.33		.63	99	47
		16.66		1.27	80	50
		33.32		2.54	44	84
		66.64		5.08	73	96
	8	4.16		.32	76	0
		8.33		.63	34	29
		16.66		1.27	51	71
		33.32		2.54	71	78
		66.64		5.08	80	92
	4	4.16		.32	33	0
		8.33		.63	40	12
		16.66		1.27	29	45
		33.32		2.54	20	75
		66.64		5.08	68	100
	2	4.16		.32	60	0
		8.33		.63	27	11
		16.66		1.27	36	44
		33.32		2.54	45	71
		66.64		5.08	122	90
		None			80	0
10.0	16	9.6	5.0	.48	74	31
		19.3		.96	93	85
		38.5		1.92	62	94
	8	9.6		.48	54	22
		19.3		.96	64	69
		38.5		1.92	38	92
	4	9.6		.48	157	0
		19.3		.96	104	16
		38.5		1.92	82	89
	2	9.6		.48	110	0
		19.3		.96	130	11
		38.5		1.92	130	63
		None			102	0
11.4	16	10.1	6.67	.67	80	0
		20.2		1.35	50	66
		40.5		2.70	68	69
		60.8		4.06	48	81
		60.8		4.06	50	82
	8	10.1		.67	97	0
		20.2		1.35	96	27
		40.5		2.70	70	60
		60.8		4.06	53	42
	4	10.1		.67	103	0
		20.2		1.35	235	4
		40.5		2.70	127	54
		60.8		4.06	59	46
	2	10.1		.67	115	1
		20.2		1.35	114	0
		40.5		2.70	100	0
		60.8		4.06	69	80
		None			97	0

TABLE 1.—(*continued*)

Particle diameter	Velocity	Total amount of aerosol	Content of DDT	Amount of DDT	Female mosquitoes	Mortality
Microns	*M.p.h.*	*Mg.*	*Percent*	*Mg.*	*Number*	*Percent*
11.9	16	13.8	4.8	.66	127	54
		19.3		.93	107	75
		22.1		1.06	222	79
	8	5.5		.26	99	23
		22.1		1.06	125	82
	4	5.5		.26	65	3
		13.8		.66	148	53
		27.6		1.32	141	93
	2	5.5		.26	112	1
		13.8		.66	198	70
		22.1		1.06	152	89
		None			87	2
13.0	16	5.1	3.0	.15	80	0
		10.2		.31	65	17
		20.4		.61	58	47
		40.8		1.22	78	64
	8	5.1		.15	67	3
		10.2		.31	65	23
		20.4		.61	52	58
		40.8		1.22	41	76
	4	5.1		.15	151	0
		10.2		.31	88	5
		20.4		.61	69	35
		40.8		1.22	42	57
	2	5.1		.15	45	0
		10.2		.31	62	2
		20.4		.61	71	46
		40.8		1.22	86	91
		None			84	1
17.8	16	12.6	3.45	.43	21	24
		25.3		.87	117	54
		50.5		1.74	72	72
	8	12.6		.43	51	0
		25.3		.87	46	17
		50.5		1.74	48	56
	4	12.6		.43	68	1
		25.3		.87	45	4
		50.5		1.74	42	67
	2	12.6		.43	51	0
		25.3		.87	39	38
		50.5		1.74	34	88
		None			38	5
20.4	16	3.9	5.8	.23	68	0
		7.8		.45	20	5
		15.6		.90	42	74
		31.2		1.81	29	79
	8	3.9		.23	49	0
		7.8		.45	58	16
		15.6		.90	83	66
		31.2		1.81	41	98
	4	3.9		.23	39	0
		7.8		.45	32	6
		15.6		.90	18	44
		31.2		1.81	42	100
	2	3.9		.23	127	1
		7.8		.45	31	6
		16.9		.98	67	78
		31.2		1.81	28	93
		None			45	0

TABLE 2.—MILLIGRAMS OF DDT PRODUCING 50 PERCENT MORTALITY OF FEMALE MOSQUITOES AS DETERMINED BY MORTALITY CURVES PLOTTED FROM PERCENTAGES GIVEN IN TABLE 1

Particle diameter	Milligrams of DDT required at speeds of			
	16 M.p.h.	8 M.p.h.	4 M.p.h.	2 M.p.h.
Microns				
1.12	18.4	126.0	184.0	80.5
2.50	2.35	5.90	14.2	32.0
3.72	2.4	5.03	—	—
4.48	1.15	1.29	3.45	10.3
5.0	1.45	1.74	3.24	6.38
6.0	1.15	2.30	2.67	3.13
7.0	1.44	2.2	1.9	3.49
7.1	—	—	1.50	1.80
8.0	.836	.912	1.44	1.6
10.0	.59	.70	1.20	1.75
11.4	1.44	1.94	2.48	2.08
11.9	.62	.62	.62	.62
13.0	.705	.705	.705	.705
17.8	.83	1.41	1.31	.99
20.4	.87	.87	.87	.87

ZOOLOGY.—*Notes on Mexican amphibians and reptiles.*[1]

HOBART M. SMITH, University of Illinois. (Communicated by HERBERT FRIEDMANN.)

Recent acquisitions by the U. S. National Museum include a number of amphibians and reptiles of special interest from Mexico. Most of them were secured, incidental to archeological labors, by Dr. Matthew W. Stirling. The remainder were collected by Dr. W. F. Foshag. Included are two state records (of *Lepidophyma f. flavomaculatum* from Veracruz and *Oxybelis aeneus auratus* from Morelos), a few rarities such as *Syrrhophus verruculatus*, and one subspecies (*Ficimia publia taylori*, n. subsp.) hitherto overlooked and unnamed.

Localities and dates of capture are recorded in detail in the accounts of each form, with the exception of San Lorenzo, where a large proportion was taken by Dr. Stirling between February and April, 1946. This small town is on the Río Chiquito, in the southern part of the state of Veracruz, municipality of Acayucán, about 17 air miles directly southeast of the city of Acayucán (see map in *On the trail of La Venta man*, by Matthew W. Stirling, Nat. Geogr. Mag. **91** (2): 137-172, illus. 1947).

Rhinophrynus dorsalis Duméril and Bibron

Two adult specimens (nos. 123542–3) are from San Lorenzo, Veracruz. The single female has small eggs in the ovaries.

Bufo cristatus Wiegmann

Five half-grown specimens (nos. 123516–20) are from San Lorenzo, Veracruz. The species differs from *B. valliceps*, which it closely resembles, in having an occipital (parietal) crest as high as the supraorbital and which terminates abruptly posteriorly instead of declining gradually; *B. cristatus* also possesses a more oval (instead of triangular) parotoid.

Leptodactylus labialis (Cope)

Two adult specimens (nos. 123528–9) are from San Lorenzo, Veracruz.

Leptodactylus melanonotus (Hallowell)

Six specimens (nos. 123521–7) are from San Lorenzo, Veracruz. The largest female measures 43 mm from snout to vent; largest male 39 mm. No horny excrescences are present.

Microbatrachylus hobartsmithi (Taylor)

Two specimens (nos. 122054–5) are from Río Chapaneal near Aquiapan (west of Zacualpan), México, collected February 28, 1943, by Dr. W. F. Foshag. They were found in spring seepage, under moss. One (no. 122055) is very small (12.5 mm snout to vent), the other an adult (19 mm snout to vent). The latter possesses vestiges of vomerine teeth.

Syrrhophus verruculatus (Peters)

A single specimen, 19 mm snout to vent, from San Lorenzo, Veracruz (no. 123530), is referred to this small species. It is a male measuring 19 mm snout to vent, and has been somewhat crushed; the belly skin has slipped to the rear exposing the internal organs.

If correctly allocated, this specimen is the only one known from the state of Veracruz, exclusive of the type from Huatusco. The only other species known which might be involved are *S. leprus* and *S. verrucipes*. *S. cystignathoides*, which occurs in the same general area, is easily eliminated on the basis of coloration; the present specimen is dark with very extensive light areas on the back. *S. leprus* is eliminated on the basis of belly coloration (it lacks all markings, while the San Lorenzo specimen is rather heavily stippled with dark below) and on the width of the digits (outer two fingers $1\frac{1}{2}$ times as wide as digits in the present specimen, scarcely enlarged in *S. leprus*). *S. verrucipes* is eliminated on the basis of its large tympanum (two-thirds diameter of orbit, while only one-half in the San Lorenzo specimen).

Other characters agree well with available descriptions of *S. verruculatus*. The belly skin is smooth, the back feebly granular. The choanae are small.

Smilisca baudini baudini (Duméril and Bibron)

Seven specimens, of which five (nos. 123508–12) are from San Lorenzo, Veracruz, and two (nos. 118635–6) are from Río de las Playas, on the boundary of the states of Veracruz and Tabasco, taken March 1–8, 1944, by M. W.

[1] Received May 5, 1947

Stirling. All those from San Lorenzo are subadults of approximately equal size, while those from Río de las Playas are large adults. One of the latter is a male with extruded vocal pouches the other a female with well-developed ovarian eggs.

Hyla arenicolor Cope

A single specimen (no. 122051) is from San Juan del Río, Guerrero, collected February 20, 1942, by W. F. Foshag. This small hamlet is about 10 miles east of Taxco and 2 miles south of Acamixtla on the banks of the Campuzo River.

Hyla rickardsi Taylor

Three specimens (nos. 123513–5) are from San Lorenzo, Veracruz, and provide a record for a fourth locality at which the species is known. Two are adult (40 mm and 35 mm snout to vent) females with fairly well developed eggs in the abdomen. Their dorsal coloration is a reddish gray-brown; indistinct, small, scattered dark flecks are present on the back, and a dark, V-shaped interorbital bar is feebly indicated. The juvenile (25.5 mm) is similarly colored, except there is a vague darker area covering much of the middle of the back; the interorbital dark bar is very distinct; the limbs are distinctly banded, and a very conspicuous short, narrow white transverse bar, preceded and followed by an equally narrow dark bar, is present immediately in front of the anus. The latter mark is visible although less well defined in one of the adults, and is absent in the other.

Rana pipiens austricola (Cope)

Ten juvenile specimens (nos. 123531–40) are from San Lorenzo, Veracruz. The largest measures 39 mm, the smallest 35 mm snout to vent. In dorsal pattern, snout length, and presence of dermal plicae they closely resemble Texan specimens of *R. p. berlandieri*, but they differ in the possession of dark mottling at least on the lips and posteroventral surface of the thighs; the mottling in some covers the entire throat and under side of the legs.

This race is envisioned as an Atlantic coastal form extending from northern Mexico (where it meets *R. p. berlandieri*) southward probably into Guatemala.

Use of this name requires explanation. Kellogg in 1932 (U. S. Nat. Mus. Bull. 160:207) pointed out that Cope, in 1886 (Proc. Amer. Philos. Soc. **23**: 517) proposed the name by remarking that the "Mexican specimens referred to in these citations [i.e., in the synonymy for '*Rana halecina* Daudin (Kalm)'] constitute a subspecies, which I call *R. h. austricola*." Kellogg observes that only 3 of the 11 citations mentioned refer to Mexican specimens. He restricts the name to the form represented by a figure published by Brocchi (Miss. Sci. Mex., Batr.: pl. 4, fig. 1, 1881), which the latter author (*op. cit.*, p. 14) states occurs in "Vera Cruz, Mexico. M. Bocourt a recueilli de nombreux échantillons de cette espéce á Salomá et á Tactu (Terres chaudes)." It appears, however, that the localities cited by Brocchi are misprints for Salamá and Tactic, both in Vera Paz (Baja and Alta, respectively), Guatemala. Both localities are indicated on Bocourt's route on the map in livraison 16 (1908) of the Mission Scientifique (opposite p. xii). The "Vera Cruz" is apparently a misinterpretation of "Vera Paz." Accordingly Kellogg's restriction of the type and type locality cannot stand, as the specimen indicated is not actually from Mexico. Therefore the name *R. h. austricola* Cope is hereby restricted to one of the other citations given by Cope (Günther, Cat. Batr. Sal. Brit. Mus., 1859: 15–16), and to the specimen *d* cited therein on p. 16 as follows: "*d*. Halfgrown: not good state. Mexico. From M. Salle's collection. Belly black-spotted." The type locality is furthermore restricted to Veracruz, Veracruz which Sallé undoubtedly visited in his travels in Mexico, as indicated by the apparently Veracruzian origin of many of the species he discovered.

That *R. p. austricola* may occur as far east as Guatemala is indicated by Brocchi's plate (*loc. cit.*), which illustrates an animal very much like the Veracruz specimens. That the species occurs in the Salamá area is verified by Schmidt and Stuart (Publ. Field Mus. Nat. Hist., Zool. Ser., **24**: 241–242. 1941) who "employ the name *pipiens* with reservation, since some geographic division of this form may prove recognizable with further study."

Rana pipiens trilobata Mocquard

A single, small, somewhat emaciated specimen (no. 122056) is from Temisco (south of Cuernavaca), Morelos. It was found in a road-

side ditch April 12, 1943, by W. F. Foshag. It possesses a broader head, apparently shorter snout, and less plicate skin than the specimens of *R. p. austricola*. Kellogg (*op. cit.*: 209) similarly describes the type of *Rana trilobata* (type locality Guadalajara, Jalisco). The race is envisioned as the one occupying the major portion of the Mexican plateau. No earlier name appears to be applicable.

Microhyla usta usta (Cope)

A single specimen (no. 123541) is from San Lorenzo, Veracruz. It contains large numbers of ants in the stomach.

Coleonyx elegans elegans Gray

A single subadult specimen (no. 123498) is from San Lorenzo, Veracruz. The prenasals are in contact.

Anolis sericeus Hallowell

Six adult specimens (nos. 123499–504) are from San Lorenzo, Veracruz. The characteristic central blue dot is present on the gular fan of males, and the supraorbital semicircles are in all separated from each other by a minimum of one row of scales.

Anolis tropidonotus Peters

A single specimen (no. 118637) is from Río de las Playas, on the boundary of the states of Veracruz and Tabasco, taken March 1–8, 1944, by M. W. Stirling. It is an adult female.

Sceloporus aeneus aeneus Wiegmann

One adult female (no. 122052) was collected by W. F. Foshag on a hill by the trout hatchery near the summit of the Toluca highway, not far from Salazar, México. The canthal is single; dorsal scales 39; femoral pores 16–18, the two series in contact medially.

Sceloporus grammicus microlepidotus Wiegmann

A single juvenile specimen (no. 122057) was collected June 1, 1943, by W. F. Foshag, at a locality between Zurumbeneo and Cerro Cárnica, Michoacán. It possesses 78 dorsals from occiput to base of tail.

Lepidophyma flavomaculatum flavomaculatum Duméril

A single specimen (no. 118638) is from Río de las Playas, on the border of the states of Veracruz and Tabasco, collected March 1–8, 1944, by M. W. Stirling. The femoral pores number 17-17, and most of the whorls of the tail (all but 4) are separated dorsally by 4 rows of scales.

Eumeces copei Taylor

One juvenile (no. 122053) was collected by W. F. Foshag on a hill by the trout hatchery near the summit of the Toluca highway, not far from Salazar, México. Pattern and scutellation are typical.

Ameiva undulata amphigramma Smith and Laufe

Three half-grown and juvenile specimens (nos. 123505–7) are from San Lorenzo, Veracruz. One (a male, the smallest) shows very little evidence of the dorsolateral dark stripe, while it is more distinct though variable in intensity (spotted) in the others (females, the largest measuring 68 mm snout to vent). The largest female shows faintly the upper lateral light line, but in the others it is not at all evident. Respectively (as numbered above) the femoral pores are 17–18 ♀, 19–19 ♀, 18–19 ♂; lamellae on 4th toe 26–27, 28–28, 26–28; rows of gulars 5 (one divided), 6 (two divided) and 4 (none divided).

Ficimia publia Cope

Twenty-two specimens have been reported of this species. Two others are available in the present collection, both from the state of Veracruz. Of prime interest is the fact that each of the latter has only 1–1 postoculars and 0–0 internasals.

F. publia is known to range from southern Veracruz to Honduras (including the Yucatán peninsula) on the Atlantic coast, and from Guerrero to western Guatemala on the Pacific. As indicated by Smith and Taylor (Journ. Washington Acad. Sci. **31**: 364. 1941) the specimens available exhibit certain variations in pattern that indicate the probability of a geographic segregation of recognizably different forms. No indication of geographic segregation of variations in scutellation was then apparent. The recent acquisitions from Veracruz indicate, however, that the population in that area is recognizably different in at least two characters of head scales.

It has been observed previously that the number of postoculars varies in *F. publia* from 1 to 2, although most specimens (17 out of 18) have two on one or both sides (2–2, 13; 1–2, 4). The only one recorded with 1–1 postoculars is the single specimen known from the state of Veracruz (Minatitlán). With the present pair, we now have 3 specimens from that state; all have 1–1 postoculars, while all others have 1–2 or 2–2. It is noteworthy that at least 2 of the non-Veracruzian specimens with 1 postocular have reduced the number through obvious fusion of the upper with the supraocular, while in the Veracruz specimens the reduction in number is due apparently to fusion together of the two scales.

Furthermore, all Veracruzian specimens lack the internasals completely. Only one other (from Yucatán) of the 20 known from elsewhere lacks them on both sides; one (Honduras) lacks the scale on one side, and one other (Petén) has it partially fused with the prefrontals on one side. Accordingly the internasals are absent in 100 percent of the known Veracruz specimens, but in only 5 percent of the remainder is it completely absent. Considering the two sides separately, only 10 percent of the individual internasals of non-Veracruzian specimens are either wholly or partially fused with the prefrontal.

These differences between the Veracruz and other populations may be summarized as follows:

Veracruz	*Elsewhere*
postoculars 1-1 (3 spec.)	postoculars 2-2 (13)
	1-2 (4)
internasals 0-0 (3 spec.)	internasals 0-0 (1)
	0-1 (1)
	½-1 (1)
	1-1 (17)

Since the Veracruz specimens inhabit an area well known to be distinctive faunistically from adjacent areas, it is reasonable to suppose that the largely distinctive characters observed in the 3 specimens available hold with reasonable constancy throughout that area. The maximum geographic range of the race is not apparent. It may be limited to the coastal plain from the Isthmus northwestward, or, as is here considered more probable, may extend eastward to the base of the Yucatán peninsula. No other specimens are known from this entire area.

That Veracruz specimens might well prove to be different from others of *F. publia* was first indicated by Taylor (Proc. Biol. Soc. Washington **49**: 54. 1936) who allocated one individual —the first recorded from the state—with *F. variegata* (which likewise normally lacks the internasals) rather than with *F. publia* (which he regarded as always having internasals). As a tribute to his discernment I suggest the race be called—

Ficimia publia taylori, n. subsp.

Types.—Holotype: U. S. N. M. no. 123491, an adult male from San Lorenzo, Veracruz, collected in the period from February to April 1946 by Matthew W. Stirling. Paratype: U. S. N. M. no. 123492, a young male with the same data as the type. Hypoparatype: The specimen originally described by Taylor (*loc. cit.*) from Minatitlán, Veracruz, at that time in the private collection of John A. Rickards of Mexico City. Present location unknown.

Diagnosis.—Allied to *Ficimia publia publia*, having a reduced number (about 30) of large blotches as wide as the interspaces on the back; differing from that race usually in lacking internasals and having only one postocular on each side.

Description of holotype.—Rostral much longer than wide, 4.0 mm in length (to cutting edge), 2.9 in width (dorsal portion only); frontal exactly as long as rostral; rostrofrontal suture 1.5 mm in width; supralabials and infralabials 7–7; preoculars and postoculars 1–1, the latter normal in size and shape; internasals 0–0; scale rows 17–16; ventrals 147; tail tip missing, the caudals 39+; total length 362 mm, tail 59 mm.

Dorsum medium brown; 30 irregularly light-edged, dark brown blotches on back, 10 on tail; blotches 2 to 3 scale lengths in extent, about as long as interspaces, reaching laterally to the 4th scale row; numerous small, irregular lateral blotches, in 1 to 3 series, alternating and/or coinciding in position with the dorsal blotches; belly unmarked except at extreme ends of ventrals, onto which some lateral spots extend.

Variation.—In the paratype, the rostral measures 2.4 mm in length, 1.9 mm in width; frontal 3.2 mm in length; rostrofrontal suture 0.8 mm in width; ventrals 148; caudals 42; total length 218 mm, tail 38 mm; other characters of scutellation as in the holotype. Dorsal

spots 30, reaching only to 5th scale row; tail spots 11; lateral spots less fused, in about 4 rows, but very irregular.

Remarks.—At present only the character of the postoculars and internasals is known to suffice in distinguishing the races of *F. publia*. Relative proportions of the frontal and rostral do not appear to be consistently different.

Rhadinaea hesperia hesperia Bailey

A single small specimen (no. 122060) was taken by W. F. Foshag June 25, 1945, at Huautla, Morelos. It is a female, with 178 ventrals and 118 caudals. The pattern agrees perfectly with the diagnosis given by Smith (Proc. Biol. Soc. Washington **55**: 185. 1942).

Tantilla bocourti bocourti (Günther)

One small male specimen (no. 122058) was taken by W. F. Foshag at Taxco, Guerrero. It measures 147 mm in total length, the tail 24 mm. Tne ventrals number 180, the caudals 49. A faint middorsal dark line is present, as well as rather extensive light marks on top of the head. The secondary temporal is no longer than broad.

Coniophanes imperialis clavatus (Peters)

Two specimens are available (nos. 123493–4) from San Lorenzo, Veracruz. They have a pattern like that of *C. i. copei* (the sides distinctly darker above than below, the middorsal dark stripe narrow and continuous), but the scale counts are those of *C. i. clavatus* (respectively the ventrals 128, 116, the caudals incomplete (♀) and 81 (♂). The specimens resemble those described by Smith (Proc. U. S. Nat. Mus. **93**: 405. 1943) which are stated to lack a separate nape spot. The temporal stripe is long and reaches to the end of the temporal scales in one, but fails to do so in another.

Imantodes cenchoa leucomelas (Cope)

One specimen (no. 118639) is from Río de las Playas, on the border of the states of Veracruz and Tabasco, taken March 1–8, 1944, by M. W. Stirling. Ventrals 235, anal divided, caudals 155.

Oxybelis aeneus auratus (Bell)

Two specimens are available, one (no. 122059) from Huautla, Morelos (June 25, 1945; W. F. Foshag), the other (no. 123495) from San Lorenzo, Veracruz. This is apparently the first record of the species from the state of Morelos. The ventrals are 192 and 194, the caudals 183 and 166 respectively. Neither has an extra preocular.

Bothrops atrox asper (Garman)

Two juvenile specimens (nos. 123496–7) are from San Lorenzo, Veracruz. The ventrals are 216 and 222, the caudals 71 and 72, respectively. One of them (629 mm in total length) contained two *Leptodactylus labialis* in nearly perfect condition, and the hind feet of a tree frog, probably *Smilisca b. baudinii*.

PROCEEDINGS OF THE ACADEMY

410TH MEETING OF BOARD OF MANAGERS

The 410th meeting of the Board of Managers, held in the Cosmos Club, October 6, 1947, was called to order at 8:10 P.M. by the President, Dr. WALDO L. SCHMITT. Others present were: N. R. SMITH, F. M. SETZLER, W. N. FENTON, W. W. DIEHL, F. L. MOHLER, J. S. WADE, A. WETMORE, F. C. COE, W. A. DAYTON, C. A. BETTS, F. B. SILSBEE, M. A. MASON, A. O. FOSTER, H. G. DORSEY, C. L. GAZIN, and, by invitation, G. P. WALTON, J. I. HOFFMAN, and E. A. CHAPIN.

The President introduced the following letter from RICHARD C. DARNELL, chairman of a Special Committee of the District of Columbia Council of Engineering and Architectural Societies:

"The District of Columbia Council of Engineering and Architectural Societies, at its last meeting, gave considerable attention to the problem of securing more effective newspaper announcement of the meetings of its affiliated societies. It was the consensus of opinion that the most desirable immediate step would be to publish a calendar of the various societies' meetings for the forthcoming week in the Sunday newspapers.

"A committee was appointed to work out the details of such a calendar and to secure the cooperation of the local newspapers in publishing it. This committee considers that such a calendar, if inaugurated, should, most ideally, list not only the meetings of affiliated societies of the D. C. Council, but should list the meetings of all scientific and technical groups of Metropolitan Washington. It should make announcements also of any special meetings or exhibits of scientific and technical interest which may be separate

from local scientific and technical societies.

"That the interests of all local scientific and technical societies may be more adequately represented in this effort, it is the pleasure of our committee to invite the Washington Academy of Sciences to cooperate. If the Academy concurs in the desirability of such an effort and wishes to join in it, it is suggested that a representative or representatives be designated to work with us."

The President was authorized to appoint a representative to work with the committee from the D. C. Council of Engineering and Architectural Societies on the calendar of societies' meetings and in securing newspaper cooperation in its publication. The President appointed Dr. FRANK THONE to be the Academy representative.

Four persons were elected to resident membership in the Academy and one to nonresident.

The President requested that in view of the purpose for which the meeting was called, namely to consider the matter of publishing an anniversary volume of the "Red Book," that the regular order of business be set aside so that the greater part of the meeting might be directed to a discussion of this undertaking.

He first, however, brought up the matter of a 31 per cent increase in cost of publishing the JOURNAL, which had been brought to his attention by the Senior Editor, Dr. W. N. FENTON. The Board voted to refer the matter of necessary changes in the JOURNAL budget to the Executive Committee for consideration and recommendations.

The President then brought up the question of an anniversary volume of the "Red Book" and discussed the results of a questionnaire he had earlier circulated among the members with respect to including in this volume the photographs of members of the Academy. Considerable discussion followed both for and against. The motion was made that an anniversary volume of the "Red Book" be published, including reproductions of photographs of the Academy members. The cost of such an undertaking was estimated at $3,000. The motion was carried with the understanding that the cost would be kept below $3,000. Further consideration of unexpected charges, such as for proofreading, etc., prompted the Board to vote a leeway of $600 from the $3,000 estimate.

The President was authorized to appoint a committee to compile such a "Red Book." The committee appointed by the President at the 407th meeting to prepare a "White Book," or Academy directory, was ordered by the Board to furnish its compiled directory material to this "Red Book" committee.

The Secretary communicated a request of the Bacteriological Society, received from its Secretary-Treasurer, Dr. C. W. BOHRER, that Dr. HARRY W. SCHOENING, of the Bureau of Animal Industry, replace Dr. CHESTER W. EMMONS as Vice President of the Academy representing the Bacteriological Society for the current year, inasmuch as Dr. Emmons was unable to carry on the duties of this office. The replacement was approved by the Board of Managers.

The meeting adjourned at 9:55 P.M.

411th MEETING OF BOARD OF MANAGERS

The 411th meeting of the Board of Managers, held in the Cosmos Club, October 20,1947, was called to order at 8:05 P.M. by the President, Dr. WALDO L. SCHMITT. Others present were: N. R. SMITH, F. M. SETZLER, W. N. FENTON, H. B. COLLINS, JR., W. W. DIEHL, F. L. MOHLER, J. S. WADE, W. W. RUBEY, L. E. YOCUM, W. A. DAYTON, C. A. BETTS, A. O. FOSTER, C. L. GARNER, H. G. DORSEY, C. L. GAZIN, and, by invitation, J. I. HOFFMAN and E. A. CHAPIN.

The following appointments were announced by the President:

Committee on Academy Awards for 1947: C. E. CHAMBLISS, General Chairman, and,

Subcommittee for the Biological Sciences: C. E. CHAMBLISS, Chairman, H. B. COLLINS, JR., F. L. LEWTON, G. STEINER, S. F. HILDEBRAND, L. E. YOCUM, and F. O. COE.

Subcommittee for the Engineering Sciences: H. L. WHITTEMORE, Chairman, L. V. BERKNER, P. S. SMITH, H. C. DICKINSON, F. M. DEFANDORF, S. H. MCCRORY, and H. C. DORSEY.

Subcommittee for the Physical Sciences: F. G. ROSSINI, Chairman, H. DIAMOND, J. J. FAHEY, K. F. HERZFELD, F. C. KRACEK, M. X. SULLIVAN, and L. D. FELTON.

Committee of Tellers: A. E. JENKINS, Chairman M. L. BOMHARD, and R. FLANNERY.

The following letter from FRANK M. SETZLER, Custodian and Subscription Manager of Publications, was introduced:

"Due to the prospect of my leaving this country soon after January 1, 1948, for an extended field trip, I hereby wish to tender my resignation as

Custodian of Publications and Subscription Manager.

"I am submitting this resignation at this time so as to assist whomever you may appoint, for my unexpired term, in learning the various procedures.

"I would also like to express my gratitude to you and past Boards for the whole-hearted cooperation extended to me."

The President announced the appointment of Dr. H. A. REHDER as Custodian and Subscription Manager of Publications to fill the vacancy created by Mr. Setzler's resignation.

The following minutes of the Executive Committee were read:

"The Executive Committee met in the Cosmos Club at 8:05 P.M. on October 13, 1947. The President, Dr. WALDO L. SCHMIDT, presided. Others present were: H. S. RAPPLEYE, F. L. MOHLER, N. R. SMITH C. L. GAZIN, and by invitation, W. N. FENTON.

"This meeting was called to consider revision of the JOURNAL budget for the year 1947 necessitated by increases in basic charges for printing of the JOURNAL, a matter referred to the Committee by the Board of Managers at its 410th meeting.

"The Senior Editor, Dr. W. N. FENTON, reported that the new contract which the George Banta Publishing Co. submitted would increase the cost of the JOURNAL about 31 per cent, or $1,240 per year. The printer's proposal that the changes become effective for the November issue indicated an increase in cost for the present year of one-sixth of the annual difference, or about $207. The Executive Committee voted favorably to recommend to the Board of Managers that the 1947 budget for the JOURNAL be increased by $225 to cover the increase in its cost of publication.

"The Committee discussed at length the matter of the illustrated 'Red Book,' including its cost to the Academy invested funds, its composition and format. No specific recommendations were made.

"The meeting adjourned at 10:10 P.M."

The Senior Editor, Dr. W. N. FENTON, presented information on certain economies that had been suggested by the printer, such as changing to a bimonthly or quarterly schedule. However, since these matters were under consideration by the Committee appointed to consider the JOURNAL and its improvement, there was no further discussion. The Board of Managers voted favorably to increase the JOURNAL budget $225 to meet the increase in cost of publication for the current year. The Board also authorized Dr. Fenton to sign the new printing contract on behalf of the Academy.

The President announced, in the absence of the Chairman of the Committee on Meetings, that Prof. I. I. RABI, of Columbia University, would speak at the November meeting of the Academy.

The Chairman of the Committee on Monographs, Dr. E. A. CHAPIN, announced that a manuscript entitled "The Parasitic Birds of Africa," by Dr. HERBERT FRIEDMANN, was under consideration and that it held promise of sale to the extent of repaying cost of publication. No specific recommendation was made to the Board of Managers pending the securing of further details as to estimated cost of publication.

The Chairman of the committee appointed to make recommendations for observance of the 50th Anniversary of the Academy, F. M. SETZLER, commented on the advisability of a dinner, brought up in the questionnaire recently circulated by the President. The results of the questionnaire showed a large majority of those responding in favor of such a dinner, but only half were willing to pay as much as $5.

The Secretary reported the death of Prof. W. P. HAY, retired member and former Vice-President of the Academy (1916), on May 26, 1947; and of Dr. RUDOLF W. GLASER, formerly with the Rockefeller Institute for Medical Research, on September 4, 1947.

FRANCOIS E. MATTHES was transferred to the list of retired members effective December 31, 1947.

The meeting adjourned at 9:30 P.M.

C. L. GAZIN, *Secretary.*

Obituaries

WILLIS LINN JEPSON lived to become the foremost systematic botanist of the Western United States. A native of California, where he was born on August 19, 1867, he delighted to think of himself as an argonaut of botany in the West. His love of California grew from his ranch-home days as a lad in the Vaca Valley of Solano County, and he determined from the day that he met Albert Kellogg in the rooms of the California Academy of Sciences on old Market Street in San Francisco that henceforth he would devote his life to California

botany. From his student days at the University of California at Berkeley, where he edited the campus literary magazine, and came to know intimately Prof. E. L. Greene, of the Department of Botany, to his last decade as emeritus professor of botany, he was constantly associated with that University. As an assistant in botany, 1891–94, then as instructor, 1895–98, assistant professor, 1899–1918, and full professor, 1918–1937, Jepson distinguished himself as the titular head of systematic botany. He was selected as one of the leading 100 botanists of the United States by Cattell in his first survey of scientific personnel in 1906. Many honors, both domestic and foreign, came to him, including his election to the Washington Academy of Sciences as a nonresident member in 1915.

Fired by a compelling desire to provide a working handbook of the native plants of California, supported by a fuller monographic account, he bent his efforts continually to that end, and religiously held to his self-set stint of preparing some copy every day of the year toward that work. He believed that it was only in this way that a scientist could realize the completion of the task that he had set himself. His credo was that a scientist carried a high duty to the Commonweal and must bow his personal desires to its good. Jepson intentionally walled out society to his evident detriment, but not, too, without some evident satisfaction. His laboratory was an "inner sanctum" whether it were in the old Hearst Mining Building or the newer Life Sciences Building. Within its locked (and often bolted!) doors he quietly worked away day in and day out, while cheering football crowds passed beneath his windows and students hurried from one college class to another. This man knew intimately nearly every corner of the state. He had crossed the Sierras at every pass, climbed Telescope Peak, breakfasted with men in the Eel River logging camps, queried "desert rats" on how they had survived a waterless trek across the Amargosa, and their philosophy and food habits, and he returned with plant collections from all these journeys. Nor were the collections hurriedly made. On his field trips he was exasperating for his habit of making the fullest painstaking notes to accompany the specimens; these field notes run to nearly sixty compactly written notebooks, all meticulously indexed. It was these data that went into the several books he authored: *Silva of California, Flora of western middle California*[1], *Trees of California*, and a *High school Flora for California*—most of the titles in two or more editions—but the best known book is certainly his *Manual of the flowering plants of California*. This was the first handbook of the California flora, describing 4,019 species. His discussion of the endemism areas of California, the revegetation of the chaparral, and even the proper method of preparing a manual, were notable. Less well known is Jepson's larger definitive *Flora of California*, upon the completion of which he was engaged for the last 25 years of his life. This *Flora* amounts to a monograph, with full bibliographic references, citation of collections, and ecological notes made in the field. Here is Jepson the taxonomist at his best. His botanical library is perhaps the finest private collection in the West. His special prize was a copy of the *Botany of the Beechey Voyage* bought in San Francisco in the nineties for $6.50!

Jepson was not without an international view, but in this he fell far behind his faculty colleague, William Albert Setchell, and, indeed, the two may be said to be most strikingly contrasted for their work in this light. As one botanist has so well said, Jepson worked as a master craftsman bent over the precise details of the flora of California. Setchell, the muralist, was engaged on a great diorama picturing the relationships of the world's floras. Yet Jepson was twice selected a delegate to the International Botanical Congress, first at Cambridge, and later at Amsterdam, serving on the important Committee of Nomenclature. Jepson's part as teacher narrowed from early days when he taught the freshman botany classes in the old "Botany Building" to his later years when his time was devoted exclusively to upper division and graduate classes in taxonomy. Students relished the eagerness that he put into his instruction, along with his anecdote and quizzical retort. His historical writings include a considerable series published in Madroño, a periodical which he founded, entitled "Botanical Explorers of California," and several biographies of naturalists prepared

[1] His doctorate thesis (Ph.D., University of California, 1899); the stock of the printed copies of the first edition destroyed in the 1906 San Francisco fire. Jepson considered this his most finished piece of work.

for the Dictionary of American Biography. He was constantly on the lookout for fresh biographical materials and amassed an astounding fund of *memorabilia* of J. G. Lemmon, E. L. Greene, and many others.

In writing of other men's lives Jepson insisted that it was dishonest to remove what he called the "thorns" from the account. Jepson's "thorns" grew mostly from his desire for recognition from the University and the public in general and his ambition to be unrivaled, and partly to some actual injustices meted out to him in his years at the University. These resulted in an almost pathologic isolation and a neurosis practically amounting to a martyr complex. It became increasingly impossible for him to forgive those who had wronged him, the wrong often amounting to a "breach of loyalty." And at times he made excruciating demands on the loyalty of his friends. Plagued by ill health for his last 30 years, his bitterness was deepened by his awareness that he could not possibly survive to finish the *Flora*—his chief goal in life. Too often Jepson absorbed the careful work of his student assistants or other botanists as his own. It was his view that the work of salaried assistants belonged to him and that no responsibility for individual credit remained. His close friends—men and women in chemistry, geology, zoology, history, and finance—inside and outside the University, prized his luncheon invitations for it was then that the wit and rapier of his meristematic mind came to the fore. Happiest in the open fields of California, he companioned democratically with professor and typesetter, bank president and ferryboat stevedore. Jepson died in Berkeley on November 7, 1946. His services to botanical science and to all those who seek to know more about the native flora of California were such that his name can never be dissociated from it and what men shall write about it.

JOSEPH EWAN

HOWARD SHREVE ROBERTS, physicist at the Geophysical Laboratory of the Carnegie Institution of Washington, died at Presbyterian Hospital, New York City, on January 30, 1947, following an operation. He was born in Philadelphia, Pa. on December 12, 1890. He attended the University of Pennsylvania and Drexel Institute and received degrees in electrical engineering from these institutions in 1912 and 1913, respectively. Subsequently, he was employed as a chemist with the Wirt Co. of Philadelphia; and in 1917 he joined the staff of the Geophysical Laboratory, where he remained until his death.

Mr. Roberts made valuable contributions in a variety of fields. His first research at the Geophysical Laboratory was on the stability relations of the oxides of iron and copper. Later he turned his attention to crystal determination by X-ray techniques; and, following that, to calorimetry, particularly the measurements of heats of melting and other transformations in silicates. His ingenuity with electrical devices not only facilitated his own researches but was freely made available to his colleagues. Particularly important in this connection was his development of a simple and effective temperature regulator that is regularly used in the extensive investigations of silicate equilibria at the Geophysical Laboratory. Indeed, in view of the fact that practicable thermostats for high-temperature furnaces were not generally available until relatively recently, it may be doubted whether certain long series of measurements would have been carried out had it not been for the Roberts regulator.

During World War I, Mr. Roberts worked with the group that was charged with the responsibility for quickly developing an adequate supply of optical glass, a material which prior to that time had not been produced in usable quality in this country. In World War II, he took an important part in the investigation of ordnance matters under the supervision of the Office of Scientific Research and Development. Here again his ingenuity and skill in the design and development of apparatus, especially those involving electric circuits, were of very great value.

Mr. Roberts was a member of the American Association for the Advancement of Science, American Chemical Society, the Philosophical Society of Washington, and the Washington Academy of Sciences. He was a tireless worker, a congenial companion with unfailing tolerance and good humor in his dealings with other persons. His untimely death will be mourned by all who knew him.

L. H. ADAMS

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VOL. 37 DECEMBER 15, 1947 NO. 12

ETHNOLOGY.—The Motilones: Some untouched tropical forest peoples in northwestern South America.[1]

PRESTON HOLDER, University of Buffalo.
(Communicated by W. N. FENTON.)

The term *Motilon* has little demonstrable ethnological significance. It evidently derives from the Spanish verb *motilar* and refers to the cropped head hair of some of these Indians. The name appears early in the Spanish historical accounts (Jahn, 1927, p. 45; Nicolas de la Rosa, 1945, pp. 202, 258, 275), where it had much the same usage it has today, namely, as a generic term referring to the Indians inhabiting the Sierra de Perijá. In this paper we shall not go into the rather literary complexities that have resulted from attempts to give names to the various hypothesized subunits of the Motilones. The actual existence of these smaller divisions is speculative until further ethnographic data are available. For a discussion of the confusing question of Motilon "tribal" names the reader is referred to Jahn, Reichel-Dolmatoff, and the Motilon article by Métraux and Kirchhoff in the forthcoming Handbook of South American Indians. For our purposes two general ecological divisions, Highland Motilones and Valley Bottom Motilones, will suffice, reducing the whole problem of nomenclature to its simplest terms. We shall consider de Booy's *Tucucu* and *Macoa*, Bolinder's *Motilones*, Jahn's *Chake*, and Reichel-Dolmatoff's *Yuko* to be in the category Highland Motilones. Jahn's *Mape* and Reichel-Dolmatoff's *Kunaguasaia* are included in our designation Valley Bottom Motilones. When it becomes necessary to suggest further subdivision geographical designations will be used.

The Motilones are an enclave of tropical rain-forest Indians inhabiting the jungles of the Sierra de Perijá in northeastern Colombia and northwestern Venezuela. Their territory includes the two distinctive environments that form the basis for the classification made above. Although it has been possible for at least 20 years to visit or study the Motilones who live in the Sierra de Perijá above an elevation of 2,000 feet, the Motilones who dwell lower down along such rivers as the Catatumbo, de Oro, and Santa Ana have remained isolated from any outside contacts except those of a violently aggressive nature. These unfriendly, unknown, and isolated Valley Bottom Motilones were our subject of major interest during an ethnographic field trip that we made for the Department of Anthropology of the American Museum of Natural History from March to December 1946.

The Sierra de Perijá is a northern extension of the main Andean Chain and serves to divide the great Maracaibo Basin on the east from the Magdalena Basin to the west. The mountains are composed of extremely tilted sedimentary beds, which exhibit considerable dissection (Notestein, 1944). The thrusts involved in the tectonic movements seem to have come from the east and resulted in a rather gently sloping and much-contorted eastern face rising from the Maracaibo Basin flats to heights of over 6,000 feet at such central peaks as the Cerros Bobali. From these crests the western slopes plunge almost vertically into the Magdalena River bottoms.

The prevailing winds of the region pour southeastward from the Caribbean across Lake Maracaibo. The warm, thoroughly

[1] Read before the Anthropological Society of Washington, March 18, 1947. Received May 8, 1947.

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saturated air masses flow upward along the eastern face of the Perijá to deposit their constituent tons of water content in the form of almost continual torrential downpours as they encounter cooler air strata. Although there are roughly two semiannual peaks of rainfall incidence interrupted by so-called dry seasons during the periods from January to March, and July to September, the country never really dries out. Rainfall records from areas near the confluence of the Ríos de Oro and Catatumbo show an annual average precipitation of 190 inches (Notestein, 1944, p. 1169). These figures represent conditions on the eastern periphery only; rainfall in the heart of the upper drainage systems of the rivers is considerably heavier.

Two results of these conditions are apparent from even the most cursory air-examination of the Perijá. In the first place, the whole eastern slope is blanketed with a dense, unbroken cover of tropical jungle. A second consequence, while not so obvious, is of even greater significance for the ecological adjustments which the Indians have made and contributes materially to their isolation. The already contorted surfaces of the eastern slopes have been further dissected by heavy water run-off and now exhibit a dendritic complex of tortuous streams flowing through narrow, steep-sided valleys of considerable gradient, depositing alluvial fans wherever their flow is impeded by frequent rapids and shoals. All these factors make the intermontane areas difficult of access. To the east of the outlying foothills the streams become large navigable rivers, which meander slowly across the level alluvial plains of the Maracaibo Basin. The peripheral sections are, therefore, easily accessible by water transportation from Lake Maracaibo. Once the hill country is entered, however, the only feasible means of travel is by shallow-draft launch during the high-water periods.

The eastern rim of outlying foothills, where the character of the streams and the country changes abruptly, is precisely the eastern limit of Motilon occupation. As we shall see, their location is principally attributable to the fact that these higher streams have easily defensible spurs and an abundance of arable alluvial basins ideally suited for the type of horticulture practised by the riverine Motilones. To the north and west in the mountain areas above 2,000 feet the Motilones have made another ecological adjustment. Thus the whole mountain mass of the Perijá from the line Codazzi–Machiques on the north to the South American Gulf Oil Co. pipeline and service road on the south is effectively held by the Motilones alone.

It is fairly certain that these peoples have opposed penetration by outside groups from the earliest times. Certainly the Conquistador Alfinger left the Motilones strictly alone when he made his great raiding trip in 1530 from Maracaibo northwest around the tip of the Perijá, then south through Valledupar and Tamalameque to La Gloria, where he turned southeast toward Pamplona, only to be killed by Indians somewhere in the neighborhood of Chinacota.[2] Uprisings of Motilones along the Río Zulia occurred as early as 1588 (Vazquez de Espinosa, p. 324). In an account dating from the early seventeenth century, Simón describes an encounter between the Motilones and Alonso Pérez de Tolosa in the Valley of Cúcuta, which differs little from conditions applying today in regions only 100 miles to the northwest (Jahn, 1927, pp. 59–60; Oviedo y Baños, 1885, vol. 1, p. 209).

There are references to attempts to missionize the Motilones throughout the succeeding centuries (Jahn, 1927, pp. 62–72; Salas, pp. 232–233; Nicolas de la Rosa, 1945, p. 275 ff.), and recently a Catholic Mission near Machiques, Venezuela, and the Protestant Evangelical Union of South America at Santa Marta, Colombia, report that they have established contact with Highland Motilones. While all the details of these efforts are far from clear, it is fairly certain that they have mostly been unsuccessful.

The reasons behind resistance to missions are probably those underlying Motilon resistance to acculturation of any sort. De la Rosa's summary from the early

[2] Castellanos, parte ii, elegia i, canto 4, 207–208. See also translation in Hakluyt Society, No. 28: vi–vii.

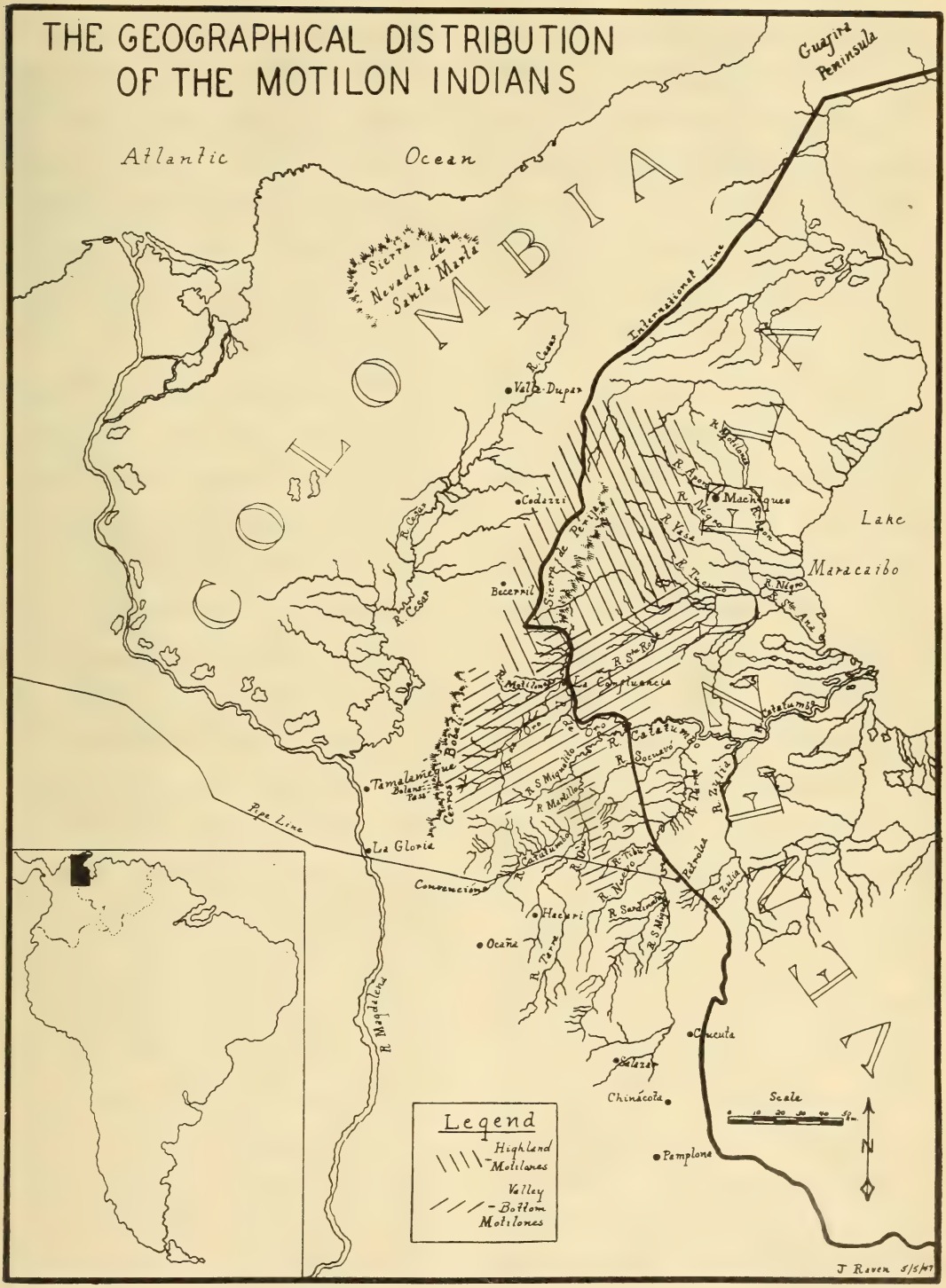


FIG. 1.—Distribution of the Motilon Indians.

eighteenth century suggests that diseases introduced among the Motilones as a result of mission contacts may have promoted hostility to outsiders at an early date, at least in the general region of Ocaña, Colombia. The very titles of ecclesiastical and administrative reports catalogued in the Colombian National Archives and the text of a recently published letter dating from the 18th century (Flotas y Sepulveda, 1944) indicate that from a very early period the colonial policy was rather punitive and consisted largely of a series of attempts to "pacify the Motilones."

A glance at the founding dates of the settlements along the southern periphery of Motilon territory certainly demonstrates that Spanish expansion to the north of the line Pamplona–Salazar–Ocaña was held back for some centuries, while the country to the north of the line Cúcuta–Hacari–Convención remained virtually unexplored until the construction of the oil pipeline in the late 1930's.[3] Along the western periphery there have been rather recent raids by Motilones against such settlements as Tamalameque, Beccerril, and Codazzi, a situation that has evidently existed for some centuries. Similar trouble is reported from the eastern border of Motilon territory. The small village of El Pilar on the lower reaches of the Catatumbo was abandoned late in the nineteenth century under pressure of Motilon attacks after it had been occupied for about a hundred years (Jahn, 1927, p. 82). Individuals who have tried to ascend the affluents of the Río Santa Ana have met with considerable hostility above the forks of the Ríos Lora and Ariguaisa and in some instances have been forced to abandon attempts to go higher up the rivers. Even today geological survey parties pass through this country with considerable caution, although authenticated instances of deaths at the hands of the Motilones are rare. Conditions apparently are not so severe along the northern and northeastern reaches of Motilon territory, particularly in the neighborhood of Machiques.

[3] Pamplona, 1549; Salazar, 1553; Ocaña, 1570; Cúcuta, 1733; Hacari, 1780; Convención, 1829.

The basic pattern of Spanish colonization undoubtedly has much to do with the undeveloped condition of the Motilon country. Throughout this section of South America the settlers who followed the original Conquistadores tended to settle in those areas having ecological conditions similar to the Iberian Peninsula. Expansion outward into the less desirable lands was so slow that today in towns like Convención on the very doorstep of the great Catatumbo jungles there are few inhabitants who have firsthand knowledge of country no more than 50 miles away.

Nevertheless there has been a slow, continuous penetration of Motilon territory from the south and east, increasing in tempo in the past 50 years, particularly along the Río Catatumbo and its affluents. During the nineteenth century and earlier there were desultory efforts to exploit the timber, fur, hide, and other natural resources of the jungle. Today small entrepreneurs still push up the navigable streams leading westward out of Lake Maracaibo; they seldom penetrate the hill country, and since their activities are sporadic and brief the Motilones are not disturbed and the intruders are able to come and go with little actual danger.

The first true penetration of Motilon country apparently came toward the close of the nineteenth century when a cattle trail was opened to the north and west of Cúcuta. It went northwest past the present-day Colombian Petroleum Co. installations at Tibu, westward across the Catatumbo, near the so-called Riocito San Miguelito, and on to the Río de Oro following that river to its high sources crossing the Cerros Bobali at Bolan's Pass and descending to Tamalameque by way of the westward-draining streams of the Perijá slopes. From 1895 to about 1907 drovers used this trail, passing herds of cattle straight through the heart of Motilon country without undue losses. Gradually the pressure of Indian raids and ambushes forced the abandonment of the project, and the trail is used today only by the Indians. When Wilcox (1921) crossed the Perijá by way of the Cerros Bobali in 1920 he found portions of the trail still usable, and 10 or

15 years later geological parties were able to use portions of it in exploring the sandstone hills 50 miles to the southeast between the Catatumbo and Tibu Rivers.[4]

The first thoroughgoing penetration of eastern Motilon territory was the ultimate result of the discovery and exploitation of oil seeps along the southwestern rim of the Maracaibo Basin. By 1905 Virgilio Barco had set up a small plant to exploit oil seeps in the neighborhood of the modern oil camp of Petrolea, and the Colombian Government had granted the famous Barco Concession. It was found that the surface

[4] See also Febres Cordero, 1918.

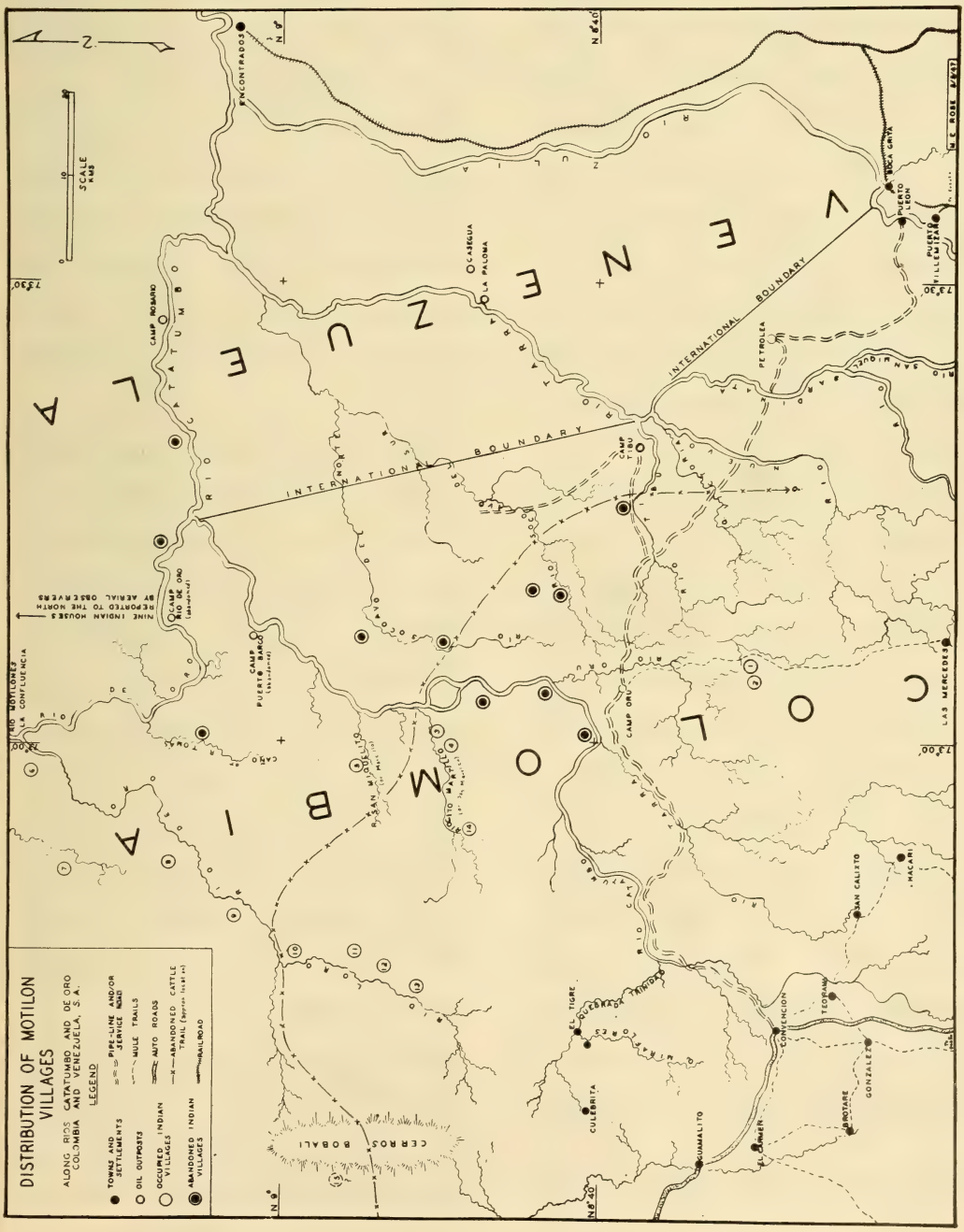


FIG. 2.—Distribution of Motilon villages.

indications represented a subsurface reserve of approximately 100,000,000 barrels of fine crude oil.[5] By the second decade of the present century a serious exploration of the oil potentials of the entire eastern Perijá foothills was under way.

Prior to this time the rather vague directives of the original treaties had served to determine the frontier of the Republics of Venezuela and Colombia. It now became necessary for these countries to establish accurately their international boundary from the region of Cúcuta to the Goajiro Peninsula. For that purpose government surveyors and accompanying troops were sent out far in advance of the temporary oil outposts. In about six years during the 1930's the surveyors reached such remote areas as the headwaters of the Río Motilones, and even penetrated the unbroken jungle along the high eastern slopes of the Cerros Bobali. Unfortunately, no ethnographic data were forthcoming from the work, and the type of contacts made were probably not conducive to scientific observation of the Motilones.

Meanwhile, permanent oil installations were being established along the whole southeastern flank of the area controlled by the Motilones. In the face of a really serious and stable penetration of their lands the Indians were powerless. During the past 40 years they have been in a constant process of retreat, abandoning village after village, and drawing back toward the west and the north. They continue desultory raids against all settlements within easy striking distance, but they no longer constitute a real threat. Today Motilones control an area limited on the southeast by the line of sandstone foothills separating the Upper Río Catatumbo from the drainage of the Río Tarra, and on the south by the pipeline we have mentioned.

As the country becomes safer and lines of communication with city markets open up, the settlers move in along all the avenues of penetration. The possibility of any Indian resurgence is lessened as the country is cleared and the encroaching population intensifies. Displaced Motilones are forced to withdraw farther and farther into territory already occupied by other Motilon villages. Of the 12 or more houses visible from the air on the Catatumbo and Río de Oro drainages it is reported that at least 6 have appeared within the past 20 years. These houses, or villages, must represent groups who lost their land in areas to the east and are undoubtedly looked upon as intruders by the people of the previously established houses.

European penetration along the affluents of the Río Santa Ana in Venezuela has not been so extensive, although settlers have now pushed south below Machiques as far as the Río Negro affluents. The whole northeastern area may soon be opened up to settlement, forcing a westward withdrawal of the Motilones, if the Venezuelan Government completes its plan to construct a highway from Machiques to Encontrados following the line of the eastern foothills of the Perijá.

If the penetration of their country continues at the present rate, within the next 50 years the Motilones are apt to find themselves not only hemmed in on all sides, as at present, but also faced with the graver problem of insufficient land to continue their basic subsistence. It seems likely that the way of life of the surviving Motilones will be quite different from that in the still integrated and vigorous villages of the Catatumbo, Río de Oro, and Santa Ana drainages. Whether the disintegration will mean total extinction of the Motilones as a people, or whether the large village units will be broken up into small family units such as we visited along the headwaters of the Río Tibu, can not be predicted. At any rate, it is evident that despite a long history of rather admirable resistance to penetration of their native land these people cannot withstand the full force of modern colonial expansion.

Despite, or because of, more than four centuries of outside pressure the Motilones have managed to maintain complete autonomy and isolation at every point except in the highlands along the northerly and northeasterly reaches of their territory. During the past 35 years at least four

[5] See Fortune Mag., March 1940: 76–83. Also Notestein, 1944.

outsiders have managed to penetrate the highland country and in some instances have established fairly peaceful contact with the Highland Motilones.[6] Since we could not visit these people the following general and necessarily incomplete summary of their culture is based on the above sources with additional personal communications from Reichel-Dolmatoff.

The Highland Motilones occupy the mountainous areas of the Sierra de Perijá north and west of the Catatumbo–de Oro drainage system above 2,000 feet. Many of the apparent cultural differences between them and the Valley Bottom Motilones seem to stem directly out of the differing ecological adjustments in the two areas of occupation. At these higher altitudes the lush jungle of the lower rivers changes its character, and game, never abundant in the lower country, is extremely scarce. The rugged terrain limits the amount of land available for horticulture, and the problem of food becomes a matter of constant concern and anxiety. The ruggedness of the country impedes free mobility, and in the absence of sophisticated agricultural techniques the size of the constituent population nuclei is restricted to the simple biological family unit, or at most a group of three or four such units clustered together in neighboring dwellings. The total population of any village seldom exceeds 15.

The "communal" house so characteristic of the valley bottom people has never been reported from the highlands. Instead, highland villages are composed of one to four small houses, each of which maybe palisaded. All the villages are located with an eye for defense, generally on some high spur or level parkland of the mountains. There is an effort to conceal the villages by making no more of a clearing than is immediately necessary for the construction of a house.

It is impossible to obtain a complete picture of Highland Motilon social organization on the basis of extant descriptions. All sources concur, however, in emphasing a basic pattern of hostility between villages which exists in spite of rules of village exogamy. One observer (Reichel-Dolmatoff, 1945, p. 69) postulates that these very rules give rise to much of the continual vendetta that is found in the hills. Raiding for wives is evidently a common practice. If other means of arranging marriages are employed they apparently do not result in intervillage alliances of any strength or duration.

According to Reichel-Dolmatoff the Highland Motilones are very inefficient horticulturists. Although they have a majority of the domesticated plants found among the Valley Bottom Motilones, they make no effort to utilize the rich, alluvial flats so important in the land-utilization patterns in the valleys. The gardens are scattered in random windfall areas, and there is little attempt to prepare and maintain large clearings. Even the considerable weaving technology depends upon the gathering of wild cotton (*ibid.*, pp. 29, 33). On the other hand, Bolinder's evidence gathered during 1914–15 indicates that some type of large communal fields were cleared in the stream beds.

The culture of these people may well be more complex than available documents suggest. Certainly they possess such features as the vertical loom, the coca complex, ponchos, a snake cult, pseudo-mummification and handling of the dead, harvest ceremonies, and religious activities correlated with the phases of the moon. It is impossible to arrive at any accurate reconstruction of the total culture of the Highland Motilones. All reports, however, definitely convey the impression that the Highland Motilones are a marginal subsistence group, living under considerable economic stress, in small scattered units having little inner social cohesiveness and no strong social or political ties with one another. If this is the situation among the Highland Motilones it is not surprising that they seem to have such a confusing and poorly integrated conglomeration of culture elements which occur elsewhere to the

[6] Bolinder, 1917 *et seq.*; de Booy, 1918; Reichel-Dolmatoff, 1945; Battista Venturello, an itinerant photographer, took a series of photographs in northern Highland Motilon country around 1942 which has not been published but is for sale in curio shops in Bogota. A partial series is on file at the Department of Anthropology, American Museum of Natural History.

northwest and the southeast in somewhat more meaningful contexts. Although they share some traits with the more technologically advanced peoples of the Caribbean littoral, we should conclude on this basis that the Highland Motilones are a peripheral variant of the Valley Bottom Motilones, a marginal enclave of a more widely spread culture pattern which prevails in the Amazon Basin.

Just as the ecological conditions of many portions of the Amazon Basin to the southeast are comparable to those in the intermontane drainage systems of the Ríos Catatumbo, de Oro, and Santa Ana, so too the basic economy and the village life of the Valley Bottom Motilones appear to approximate those of the Amazonian riverine horticulturists. The population nucleus here is a group of 40 to 80 persons living together in a permanent village, which consists of a single, large, pole-and-thatch communal house 50 to 80 feet long, with its associated fields. The typical house is located in the center of a 300-foot clearing on the top of an easily defended spur rising 50 to 100 feet above the alluvial flats at its base. Along the river bottom a mile or so from the house are three or four garden clearings, generally 300 to 400 feet in diameter. The house itself is set back from the river to give its occupants a controlling view of it for some miles in either direction, and the approaches to the house are beset with ambush points. The house clearing is a garden as well as a very effective barrier against invaders armed with bows and arrows.

The villages are spaced at intervals of about 10 miles along the courses of the rivers and their tributary creeks. The 10-mile circle thus indicated probably represents a hunting range large enough to supply the game necessary to supplement the basic food crops of the villages. Women apparently provide the mainstay of village life by horticultural work. The men are responsible for clearing, hunting, and the protection of the village from aggressors.

In an appended trait list we have listed the food crops. These are carefully tended, and the gardens show evidence of considerable labor. The defects of the slash-and-burn type of farming as practiced by tropical horticulturists are well known; fields are exhausted after no more than five or six years, and new clearings must be made in the jungle. Acquisition of steel cutting tools by the Motilones on their raids against encroaching settlers has made the task of clearing somewhat less arduous, but it still calls for a tremendous expenditure of time and labor.[7]

Conditions of life are not easy. Constructing fish weirs and traps and hunting with bow and arrow the never-abundant game—tapirs, sloths, wildcats, turkeys, bush hens, monkeys, and small rodents—must occupy a considerable portion of the men's time.

In addition, there is the ever-present problem of warfare. Motilon territory becomes progressively smaller as the Motilon settlements move inward. A constantly diminishing area of arable land and hunting territory is available. In the face of increasing outside pressure, if there were any social foundation upon which confederacies or even temporary military alliances could be made we should expect them to appear as they did under similar conditions among the Iroquois, Dakota Sioux, Sahaptins, and other groups in North America; some of whom had even less political organization upon which to base cooperative efforts. Evidence from Amazonian horticulturists and the data from Highland Motilones suggest that the primary factor preventing the development of confederacies is a basic and thoroughgoing pattern of outgroup aggression, which isolates the Valley Bottom villages one from the other.[8]

Among the constituent villages of the Valley Bottom Motilones intercourse may be further complicated by considerable linguistic diversity. The isolation of these Motilones is so complete that no zone of acculturation of any sort exists along the southern and southeastern boundaries of the Motilon territory. No outsider knows

[7] We were able to estimate the time necessary to clear a house circle and construct a house—something under two months—with steel cutting tools and probably using the labor of the entire village.

[8] An idea of the temporal depth to this picture will be given in a forthcoming paper on the archeology of the area.

a word of Valley Bottom Motilon language. We are, therefore, rather dubious of Rivet's sweeping inclusion of all Motilones in the Carib linguistic stock. In our field work we were able to make a few brief contacts with small family units of Motilones in the hill country around the headwaters of the Río Tíbu. A word list obtained from them showed a phonetic pattern unique for this part of South America. Rather garbled statements from a Motilon boy who was captured more than seven years ago when he was five years old indicate that dialectical variations exist between neighboring Valley Bottom villages in the Río de Oro region.

Warfare is an important activity among the Valley Bottom groups. Retaliation against encroaching Europeans takes place during the annual dry season hunts when complete villages move far downstream on balsa timber rafts to hunt alligator eggs before they return overland to the village sites and resume agricultural activities. Sporadic attrition raids by smaller groups plague oil installations on the eastern border of the Valley Bottom territory.

All this warfare follows a consistent pattern that not only reflects a sub-Neolithic technological level but derives out of the intense interest of the men in hunting. Men do the fighting even when women accompany war parties. Their only weapons are black palm bows and cane arrows with 3- to 4-foot-long black palm points.[9] The manufacture and possession of arrows are almost an obsession among all Motilones. Raids conducted against Motilon villages net upwards of 300 arrows and 40 or 50 bows from the "arsenal" of a single house. Motilon tactics are those employed in jungle warfare the world over: raid, ambush, attrition, avoidance of pitched hand to hand battle. Motilon raiding and ambush parties are normally small and extremely mobile, seldom numbering more than 20 individuals, often as few as 6. These groups exhibit a loose over-all coordination. The constituent groups of three to four appear free to operate in a particularistic fashion, suggesting that the kinship ties of individual or constitutent families have greater importance in the village than any control imposed by the large, extended family.

From comparative data in the surrounding areas it is safe to assume that if rules of village exogamy do exist among the Valley Bottom groups they may have little permanent effect on inter-village hostility patterns. It is doubtful that even integrative ceremonies for planting, harvest, or rites of passage operated on an intervillage level.

That the whole Motilon group should have remained relatively unchanged during the past 400 years is little short of amazing. Certainly, their attitude toward outsiders is one to discourage acculturation. Such a situation is unique enough to command the attention of modern anthropology. The problems to be studied are obvious. The whole question of cultural stability can be examined here, in particular, the ability of such technologically "poor" groups to withstand outside aggression and influences even when they are torn by severe inner conflicts. Here is an exceptional opportunity to study the functioning of a so-called primitive group as it exists without innumerable "foreign" elements. The underlying motives and processes of acculturation might well be further illuminated and in this instance it may be possible to witness the transition of a group from conditions of isolation and relative self-determination to disintegration, extinction, or new orientation. The end result for the Motilones will depend not only upon the factors at work in the present situation but upon whether modern social science can have constructive application in a situation of severe social conflict.

The severity of the Motilon "problem" from the standpoint of the encroaching groups is certainly sufficient to encourage other than punitive action on the part of the various interests involved. It is conceivable that the two Republics which govern the territory will recognize the value of assigning adequately trained resi-

[9] Reichel-Dolmatoff notes a prevalence of foreshafted iron arrows of distinctive form among the Highland Motilones. These are rare in collections from the valley bottoms, and in both areas are probably for hunting rather than war although on at least one occasion a man was hit with an arrow of this type in the Catatumbo region.

dent ethnographers to analyze the situation and make a practical application of their findings to actual field conditions. The recent investigations by the Instituto Etnológico Nacional of Colombia carried out by Reichel-Dolmatoff may be a step in this direction. More complete ethnographic studies of these Highland Motilones would be invaluable. It is, however, the crucially situated Valley Bottom Motilones who constitute the only "untouched" group and who furnish the major problem in aggression against outsiders.

Thus far the only effort made to carry out a consistent and scientific study of the Valley Bottom Motilones has been made possible through the cooperation of a private North American concern. The Colombian Petroleum Co., in sponsoring the American Museum of Natural History's expedition, showed unusual foresight and set a precedent for a manner in which these problems may be approached to avoid a repetition of the tragic failure of the "Indian policy" pursued by the United States up to a fairly recent period.

Although the results of the Museum's expedition were fundamentally negative from a classical ethnographic point of view, they did suggest the possibility of making contact with these people along the lines followed by Curt Nimuendaju with the Parantintin of Brazil (Baldus, 1946). It is hoped that applied anthropology has now advanced far enough to command the authority necessary to prevent aggressions by the encroaching groups if "peace" could be established with the Motilones. Otherwise there might well be a repetition of the Parantintin tragedy.

The primary difficulty in any program of making contact with the Valley Bottom Motilones is, of course, that there is no "trade language" in the Motilon area. Furthermore the language of the Valley Bottom Motilones is unrecorded and unknown. The language of the Highland Motilones may prove to be intelligible to the Valley Bottom groups. Once an opening of this sort is found, the way can be open for a scientific study of some 1,000 to 1,500 completely untouched American aborigines.

SELECTED LIST OF CULTURE ELEMENTS FOUND AMONG THE MOTILONES

x Presence demonstrated.
— Absence demonstrated.
(?) Presence probable, but not demonstrated.
? Presence doubtful.

	Valley Bottom	*Highland*
Platform beds	x (Catatumbo)	x
Hammocks	x (Río de Oro)	—
Suspension bridges	x (Río de Oro)	—
Communal dwellings	x	—
Large communal fields	x	(?)
Balsa timber rafts	x	—
Fish weirs (stone and leaf)	x	x
Grinding stones	x	x
Face and body painting	(?)	x
Digging stick	x	x
Gourd containers	x	x
Tiger tooth beads (men)	x	—(except Upper Tibu)
Seed beads (women)	—	x
Chicha	x	x
Famine cannibalism	?	x
Snake cult	x (Río de Oro)	x
Handling and reburial of dead	(?)	x
Vertical loom	(?)	x
Spindle whorl and ring suspension for spinning	(?)	x
Poncho (men)	—	x
Cape (women)	—	x
Pubic apron (men)	x	—
Pubic apron (women)	x	x
Latticework basketry	x	x
Mats	x	x
Wicker fish trap	(?)	x
Woven fire fan	—	x
Feather fire fan	(?)	x (Upper Tibu)
Woven headbands	x	x
Thread cross	(?)	x
Cats cradle	(?)	x
Ritual bullroarer	(?)	x
Double end stickcomb	(?)	x
Bast and agave cordage	x	x
Bamboo quivers	x	—
Wooden quivers	x	x
Miniature bird arrows	—	x
Blunt bird arrows	x	—
"Harpoon" arrows	x	x
Elaborate arrow bindings	—	x
Palm wood points	x	x
Iron triangular points	x	x
Arrows unfeathered	x	x
Unsprung bow	x	x
Musical bow	(?)	x
"Ax" flute	(?)	x
Pan-pipes	(?)	x
Tubular flute	(?)	x
Pottery vessels	x	x
Tobacco pipes	(?)	x
Tobacco	x	x
Cotton	x	x
Potatoes	(?)	x
Corn	(?)	x
Sweet manioc	x	x
Bananas and plantains	x	x
Beans	(?)	x
Sugarcane	x	x
Pineapple	x	x
Papaya	x	x
Peppers	x	x

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BOTANY.—*Studies in* Lonchocarpus *and related genera, I: A Synopsis of* Willardia.[1]

FREDERICK J. HERMANN, U. S. Department of Agriculture.

The relationship of the leguminous genus *Willardia,* of the tribe Galegeae, characterized by the possession of dehiscent pods, with *Lonchocarpus,* of the tribe Dalbergieae, which have indehiscent fruits, would not appear to be very close. The resemblance of the two groups is so great, however, particularly in the flowering or in the merely vegetative condition, that an observer as astute as Bentham (*1*) erroneously referred to *Lonchocarpus* two species which, when subsequently collected in the fruiting stage, proved to belong to *Willardia*; and no less than five additional arborescent legumes from Mexico and Central America described by other authors as Lonchocarpi now appear to be logically assigned to *Willardia.* A brief synopsis of *Willardia,* heretofore supposed to comprise but three species, may consequently be useful.

The genus *Willardia* was established by J. N. Rose (*2*) in 1891, its basis being Sereno Watson's *Coursetia mexicana,* which had been described from fruiting material alone. Rose pointed out that additional specimens in flower showed the plant to be

[1] Received June 17, 1947.

amply distinct from *Coursetia* in its "truncate" calyx and glabrous style. In 1905 Rose (*3*) added a second species to the genus, *Willardia parviflora*. Standley (*4*), in his *Trees and shrubs of Mexico* (1922), transferred Bentham's *Lonchocarpus eriophyllus* to *Willardia* and provided a key to the three species of the genus then known. The most recent account of the group appeared in North American Flora in 1924, wherein Rydberg (*5*) presented a comprehensive treatment of the three species.

In current studies of the Mexican and central American material of *Lonchocarpus* from the U. S. National Herbarium and the Chicago Natural History Museum by the writer it was noted that an excellent series of collections by Hinton of *Lonchocarpus obovatus* Benth. included several specimens bearing pods that had a decidedly unconventional aspect for *Lonchocarpus*. In contrast with fruits characteristic of this genus, highly variable though they are, these pods were almost marginless with the epidermis conspicuously marked by elongated resin ducts. Both of these features are possessed by the legumes of *Willardia*, and closer inspection revealed the fact that several of the oldest pods showed the beginning of dehiscence. From comparison of the floral and vegetative morphology with that of the latter genus the Hinton collections were found to fall well within its limits, while their comparison with a fragment (consisting of a flower and a leaflet) of the type in the U. S. National Herbarium and with a photograph of the complete type specimen of *Lonchocarpus obovatus* showed them to be an excellent match with it.

The tardily dehiscent pods of species of *Willardia* leads to their frequent confusion, even during most of the fruiting stage, with *Lonchocarpus*. A second instance of such misidentification appears in the case of Harms's *Lonchocarpus argyrotrichus*. Collections by Hinton again proved to be the solution here. His flowering specimen, *8059* (distributed as *Willardia eriophylla*), agrees in all essential points with the type collection of *Lonchocarpus argyrotrichus*, but mature pods collected seven months earlier from the same plant are plainly dehiscent.

Such differences as could be found between *Lonchocarpus lindsayi* Standl., recently described from Panama, and *L. calderoni* Standl., of El Salvador, appear to be wholly quantitative, so that *L. lindsayi* seems better regarded as a geographic variety of the latter. *L. calderoni*, however, is apparently identical with *L. salvinii* Harms, described from Guatemala, which, in turn, differs in no essential character from the Mexican *Robinia schiedeana* Schlecht. Schlechtendal's species was transferred to *Lonchocarpus* by Harms at the same time that he proposed *L. salvinii*, from which he believed it differed "*durch etwas kleinere Kelche und zartere meist einblütige, selten zweiblütige Pedunculi.*" Measurements of a large series of calyces, however, fail to substantiate any difference in size, and the slenderer, mostly 1-flowered, seldom 2-flowered, peduncles of the type of *Robinia schiedeana* are to be ascribed to the greater maturity of the specimen: fruiting material of *L. salvinii* displays conspicuously elongated peduncles upon which more than one pod is only rarely developed. In none of the material described under the above names are the wing petals adherent to the keel, as they are in *Lonchocarpus*: the distinctly cyathiform calcyces would be another anomaly in that genus; and although the fruiting specimens do not have pods old enough for dehiscence to have begun, they are characteristically those of *Willardia*, the resin ducts being quite conspicuous.

The transfer to *Willardia* of the three species considered to be distinct in the above discussion results in doubling the number of species so far known in this genus.

TAXONOMIC TREATMENT

Willardia Rose, Contr. U. S. Nat. Herb. 1: 97. 1891. Type species: *Coursetia mexicana* S. Wats.

KEY

Corolla 6–15 mm long, glabrous or glabrate; mature leaflets glabrous to sparsely pilose; pods glabrous to puberulent or sericeous.

Pods narrow (9–12 mm wide), the margins plainly thickened.

Corolla 6–7 mm long; leaflets 11–21, very small (8–16 mm long); pods glabrous .....1. *W. parviflora*

Corolla 10–15 mm long (in *W. schiedeana* var. *lindsayi* 8.5–9.5 mm); leaflets 5–12 (15), larger, 20–45 mm long (sometimes only 10 mm in *W. schiedeana* var. *lindsayi*); pods glabrous to silky-strigose.
Pods glabrous, abruptly contracted into a stipe; corolla 8.5–11 mm long. . . . . 2. *W. schiedeana*
Pods sericeous, long-tapering at the base; corolla 12–15 mm long. 3. *W. mexicana*
Pods broader (13–18 mm wide), the margins scarcely evident. . . . . 4. *W. obovata*
Corolla 20–23 mm long, at least the banner densely pubescent; mature leaflets silky-strigose to velutinous; pods velutinous.
Leaflets 11–23, relatively small (15–35 by 8–10 mm); pubescence of calyx and corolla tomentose to velutinous; pods 9–13 by 1.3 cm, thin, velutinous. . . . . 5. *W. eriophylla*
Leaflets 7–9, larger (30–75 by 15–30 mm); pubescence of calyx and corolla sericeous; pods 8–13.5 by 1.7–2.3 cm., thick and rigid, densely velutinous to lanate. . . . . 6. *W. argyrotricha*

1. **Willardia parviflora** Rose, Contr. U. S. Nat. Herb. **8**: 313. 1905.

Type locality: Yautepec, State of Morelos, Mexico, *Pringle 8470*.

Distribution: Lava fields and dry, sunny fields, Yautepec, and between Cuernavaca and Alpuyeca, Morelos.

Representatives: *I. K. Langman 3516*; *Pringle 8470, 11347; Rose & Painter 6576*.

2. **Willardia schiedeana** (Harms) Hermann, comb. nov. *Robinia schiedeana* Schlecht., Linnaea **12**: 306. 1838. *Lonchocarpus schiedeanus* Harms, Fedde Rep. Spec. Nov. **17**: 324. 1921. *Lonchocarpus salvinii* Harms, l.c. 323 (type: Volcán de Fuego, Guatemala, *Salvin* in 1873–74). *Lonchocarpus calderoni* Standl., Journ. Washington Acad. Sci. **15**: 476. 1925 (type: Cerro de Guayabal, El Salvador, *S. Calderón 22022*).

Type locality: Between Veracruz and Santa Fé, Mexico *Schiede 621* (Field Mus. photo no. 18406).

Distribution: Forests and clearings, State of Veracruz, Mexico, Guatemala and El Salvador.

Representatives: *Calderón 1979, 2022; Salvin* in 1873–74; *Standley 58059, 64752, 64872*.

2a. **Willardia schiedeana** var. **lindsayi** (Standl.) Hermann, comb. nov. *Lonchocarpus lindsayi* Standl., Field Mus. Publ. Bot. **17** (2): 195. 1937.

Type locality: Bejuco, Canal Zone, Panama, *W. L. Lindsay 446*.

Distribution: Known only from the type locality.

Representatives: *W. L. Lindsay 399, 446*.

Differs from the typical form in its smaller leaflets (10–25 by 7–13 mm), slightly smaller corolla (8.5–9.5, rather than 10–11, mm long), and particularly in its short pods (3–5.5, rather than 5.5–8, cm in length).

3. **Willardia mexicana** (S. Wats.) Rose, Contr. U. S. Nat. Herb. **1**: 98. 1891. *Coursetia* (?) *mexicana* S. Wats., Proc. Amer. Acad. **21**: 424. 1886.

Type locality: Hacienda San Miguel, Chihuahua, Mexico, *E. Palmer "C"*.

Distribution: Forested slopes, southeastern Chihuahua, Sonora and Sinaloa, Mexico.

Representatives: *Gentry 1446, 2205; Ortega 4556, 5217, 5502; Palmer "C", 332, 717*.

4. **Willardia obovata** (Benth.) Hermann, comb. nov. *Lonchocarpus obovatus* Benth., Journ. Linn. Soc. **4**: Suppl. 92. 1860.

Type locality: Chilla, Puebla, Mexico, *Andrieux* 440.

Distribution: Dry hills, barrancas, and llanos States of Michoacán and Mexico to Puebla and Guerrero, Mexico.

Representatives: *Andrieux 440; Hinton 3742, 5523, 5937, 5942, 5946, 6290, 6958, 6959, 7041*.

The leaflets in this species (5 to 9 in number) are extremely variable in outline and vesture. Ranging from 1.6–4.5 cm by 0.9–2.5 cm in size, they are commonly ovate-elliptic with tapering base and obtuse apex, but in *Hinton 6290*, for example, they are predominately orbicular-ovate to broadly ovate (the terminal generally obovate) with emarginate apices, whereas in *Hinton 6959* they are elliptic to oblanceolate with acute apices. These variations do not appear to be correlated with the season, as does the vesture. Very young leaflets are usually densely sericeous, especially beneath, but at maturity they become completely glabrous. The pods (6–15 cm by 1.3–1.8 cm) are elliptic to oblong, long-tapering at both ends, thin, very flat, and at first finely appressed-sericeous with a marked silvery sheen but becoming glabrate and tawny-brown.

5. **Willardia eriophylla** (Benth.) Standl., Contr. U. S. Nat. Herb. **23**: 483. 1922. *Loncho-*

carpus eriophyllus Benth., Journ. Linn. Soc. **4**: Suppl. 94. 1860.

Type locality: Chilla, State of Puebla, Mexico, *Andrieux 439.*

Distribution: Lava fields and rocky gulches, States of Puebla, Morelos, and Guerrero, Mexico.

Representatives: *Langlassé 236; Pringle 8987, 11348.*

6. **Willardia argyrotricha** (Harms) Hermann, comb. nov. *Lonchocarpus argyrotrichus* Harms, Fedde Rep. Spec. Nov. **17**: 320. 1921.

Type locality: Near Tlaxmalac, District of Hidalgo, State of Guerrero, Mexico, *Seler 4276*

Distribution: Hills, States of Mexico and Guerrero, Mexico.

Representatives: *Hinton 7085, 8059; E. W. Nelson 2043; Seler 4276.*

In addition to the characters given in the foregoing key for the hitherto undescribed pods. represented in *Hinton 7085*, it may be mentioned that they are approximately oblong in outline, thick-margined, especially the vexillar suture, deep tan in color, and 1–3-seeded (seed 13 by 9 mm, semilunate, dark mahogany-red). The blades of the leaflets, borne on petiolules 6–8 mm long, are strigose above and somewhat appressed-pilose beneath; in *Hinton 7085* (in fruit) they are oblanceolate, tapering at the base, with an abruptly acuminate apex (45–63 mm by 18–22 mm), whereas in *Hinton 8059* (same tree in flower) they are oval-elliptic, rounded at the base, and obtuse at the apex (75 by 30 mm).

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ENTOMOLOGY.—*A new species of* Pristoceuthophilus *from Oregon, and remarks on certain special glands of Orthoptera (Gryllacrididae; Rhaphidophorinae).*[1]

Ashley B. Gurney, *U. S. Bureau of Entomology and Plant Quarantine.* (Communicated by R. E. Blackwelder.)

The genus *Pristoceuthophilus* occurs in Mexico and the western parts of the United States and Canada. The species superficially resemble those of the well-known genus *Ceuthophilus* but differ conspicuously in that males of most species bear large spines, tubercles, or other distinctive structures on the dorsum of the abdomen. There are additional differences between the two genera, such as the crenulations of the ovipositor of *Pristoceuthophilus*, rather than distinct teeth which rarely are absent in *Ceuthophilus*, and the absence in *Ceuthophilus* of a basal, ventral, sensory seta on each tarsal claw. My friend Borys Malkin, of the University of Oregon, has recently sent to the National Museum specimens of a new species of *Pristoceuthophilus*, which has the dorsum of the male abdomen specialized in a very ornate and remarkable manner. The only previously described species which approaches the new one in dorsal specialization is *gaigei* Hubbell, 1925, described from the Olympic Mountains, Mason County, Wash. Although there is no definite information concerning the benefits which these insects may derive from the specialized abdominal structures, glandular activity may be involved, and a discussion of such functions in related Orthoptera is included to point out the nature of this possibility.

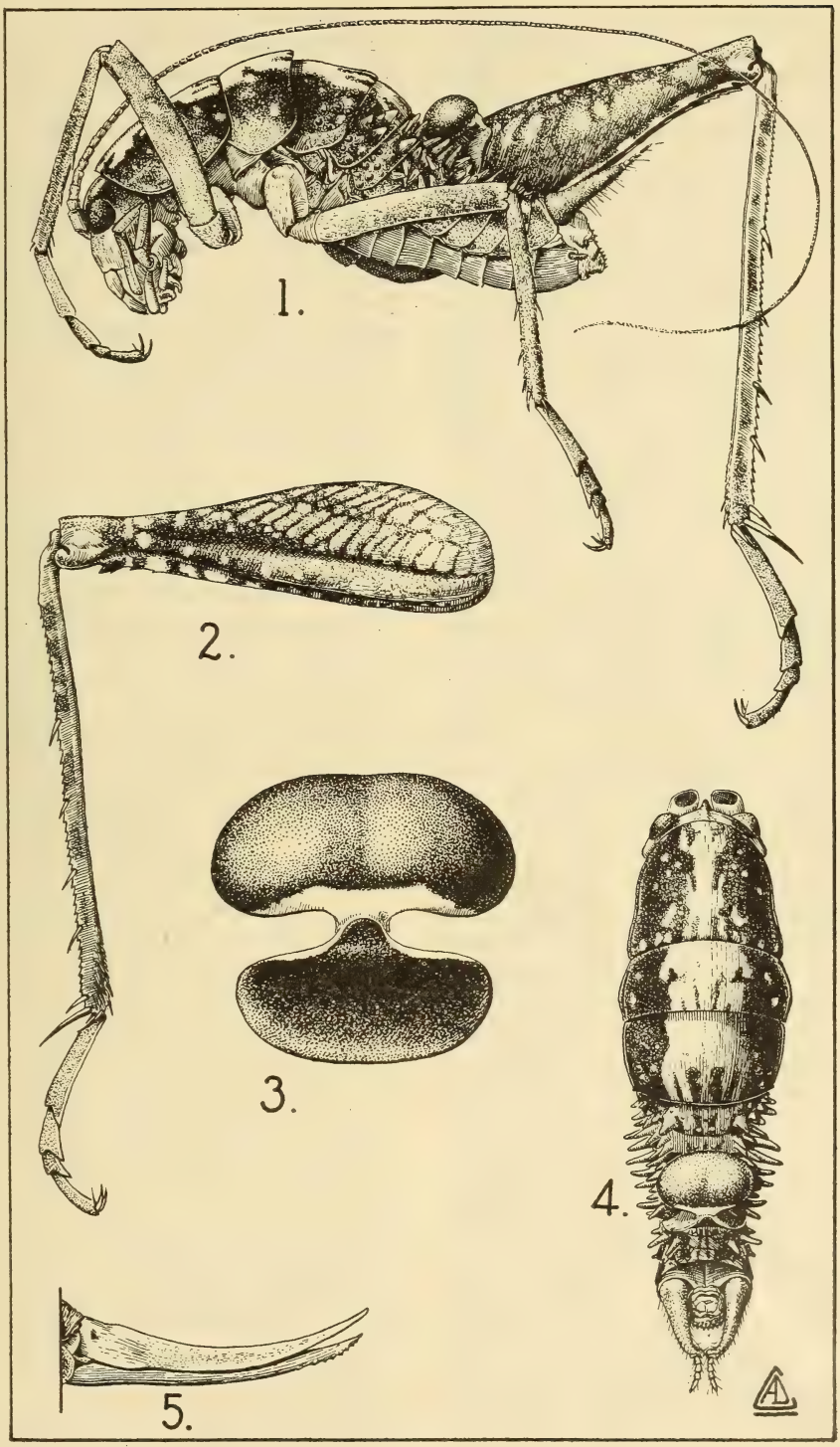
My appreciation is extended to Mr. Malkin for making this interesting species available for study; also to my colleague Arthur D. Cushman, for preparing the illustrations.

Pristoceuthophilus sargentae, n. sp.

Figs. 1–5

Male (holotype).—General size about average for genus. Head with fastigium extending in front of eyes, moderately less elongate and acute than in *celatus* (Sc.). Antenna delicate, slender, with about 130 segments (plus a few lost apical ones).

[1] Received May 22, 1947.



Figs. 1–5.—*Pristoceuthophilus sargentae*, n. sp.: 1, Holotype, lateral view (left hind leg missing); 2, same, externolateral view of right hind leg; 3, same, posterior view of Hubbell's organ; 4, same, dorsal view (legs and antennae not shown); 5, allotype, lateral view of ovipositor. (Drawings by Arthur D. Cushman.)

Thorax as figured; metanotum with about 12 tubercles, varying from low to indistinct, on ventroposterior portion of each side. Front femur unarmed. Front tibia with 3 small spurs on each ventral margin, distal one scarcely more than half the length of 2 basal ones; 2 apical spurs on each side, dorsal one two-thirds the length of ventral one, ventral apical spur slightly longer and stouter than basal spur of ventral tibial margin. Middle femur with 2 (right femur) or 3 (left) spurs, varying from minute to small, on each ventral margin; genicular lobe of posterior surface with a single spur. Middle tibia with 2 (right) or 3 (left) staggered dorsal spurs and 3 pairs of ventral spurs; 2 apical spurs on each side, dorsal one about three-fourths the length of ventral one. Hind femur with short, acute tooth at apex of each ventral carina, preceded by 6 (anterior) or 9 (posterior) serrations which decrease in size toward base of femur; genicular lobe unarmed. (Left hind leg lost.) Hind tibia straight, with 5 pairs of dorsal spurs, interspersed with numerous serrations; apex armed on each side with 2 small ventral spurs, a medium sized one at extreme apex and a dorsal one twice the length of apical one, posterior dorsal spur slightly longer than anterior one and three-fifths dorsal length of basal tarsal segment.

Abdomen with terga I–VIII armed with blunt tubercles and long, conical spines as figured; basic arrangement of spines and tubercles 2 rows per tergum, a partial third row on tergum I, anterior row lacking on terga VII and VIII, development on median portion of terga obsolete; posterior row of tubercles developed nearly to ventral margin on terga I–III, extending decreasingly short of ventral margin on succeeding terga; armature of tergum VIII reduced to 1 small and 2 obsolete posterior tubercles each side of median line. Tergum IV bears a large median structure with a subovate anterior portion covering entire median portion of III and posterior margin of II; a posterior development of this organ vertical, shelflike, covering median portion of V and anterior margin of VI; this organ well sclerotized (with exception of region of median constriction, shown pale in illustrations), anterior half smooth and shining, posterior half minutely roughened, traces of what may be secretory pores at point of maximum constriction. Cercus with basal two-thirds unsegmented, this portion terminated medially by a densely pubescent, hemispherical knob, apical third comprising 5 segments. Supra-anal plate triangular, longitudinally grooved. Ventral aedeagal lobe membranous, covered medially with short, stout spinules. Subgenital plate simple, broadly emarginate apically, each lateral posterior angle bearing a short, simple style.

Coloration: Pattern of dorsal surface as in Fig. 4, with dark areas of black grading on lateral portions of nota into russet and, at ventral extremities of nota, into gray mottled with dark spots; pale areas of vertex and nota amber yellow; fastigium black with a pale gray transverse band midway of its length; spines and tubercles of terga mustard yellow, a few dark brown at base, some short ones, particularly on tergum I, entirely dark; special organ of IV cinnamon-buff; antennae ochraceous-orange in basal third, annulate with occasional pale brown segments, the latter more numerous apically, giving a predominantly brown color, with pale annulations at intervals. Ground color of legs predominantly dark purplish gray, spotted and streaked with lighter color varying from amber yellow to straw yellow; tarsi mainly amber yellow.

Measurements (length in millimeters): Body, 11.5; antenna, approximately 28; pronotum, 3.3; front femur, 4.5; hind femur, 9.4; hind tibia, 10.5; cercus, 2.8.

Female (allotype).—General form as in male; somewhat larger and more robust (though body is shorter due to different position); differing as follows: Front femur with small subapical spur on ventroanterior margin; middle femur with minute subapical spur on ventroposterior margin, otherwise unarmed except for posterior genicular spur (right middle leg lost); hind femur without apical teeth on ventral carinae, about 6 (anterior) and 9 (posterior) serrations on apical third of carinae; posterior dorsal spur of apical group on hind tibia seven-eighths dorsal length of basal tarsal segment. Thorax and abdomen simple, normal for females of genus. Cercus unspecialized, obsolete segmentation indicated on apical half. Subgenital plate simple, the apex broadly and evenly rounded. Ovipositor smooth, shining; lower valve with 9 ventral crenulations on apical fifth (Fig. 5).

Coloration: Nota with a median, longitudinal pencil stripe of ivory yellow; pale areas not confluent as in male, consisting of general

sprinkling of amber-yellow spots on dark background. Terga spotted as on nota. Ovipositor empire yellow, basal fourth somewhat paler. Antennae darker than in male. Coloration otherwise essentially as in male.

Measurements (length in millimeters): Body, 11.0; pronotum, 3.6; front femur, 4.9; hind femur, 10.0; hind tibia, 11.6; cercus, 3.0; ovipositor, 6.0.

Nymphs.—There are 2 male and 5 female nymphs, varying in body length from 7 to 10 mm (hind femur, 6–7 mm). Males show traces of dorsal tubercles, no sign of organ on tergum IV. Dorsal color pattern essentially as in male type, in one female varying toward that of allotype. Antennae brown, with pale annulations at intervals.

Type locality.—Oregon Skyline Trail, Three Sisters Primitive Area, Lane County, Oreg. (elevation 5,700–6,000 feet).

Type.—Male, U.S.N.M. no. 58319.

The male type, female allotype, and seven immature specimens were collected August 18, 1946, on the Oregon Skyline Trail about 3 miles from Frog Camp. (Collectors: Samuel Sargent, Mrs. Sargent, Borys Malkin.) This part of the trail is sometimes called Obsidian Trail. Mr. Malkin writes that more than 20 specimens were seen, scattered from 1 to 6 feet above ground, all under the loose bark of a single standing tree. Only the specimens here reported were captured. The tree was believed by him to be the mountain hemlock (*Tsuga mertensiana* (Bong) Sarg.), of which there is a large stand in the vicinity, or possibly the silver (or lovely) fir (*Abies amabilis* (Dougl.) Forbes). The tree is located at a point on the trail just before the latter turns and follows the first lava flow from the Middle Sister. (The Three Sisters are the remnants of extinct volcanoes, each said to have been originally more than 10,000 feet high.)

The species is named in honor of Mrs. Samuel Sargent, whose enthusiasm for collecting, together with that of her husband, contributed significantly to the discovery of this unusual camel-cricket.

This species is most closely related to *gaigei*, from which it differs noticeably in the shape of the dorsal organ of tergum IV. This organ in *gaigei* does not overlap III anteriorly, and only slightly over V posteriorly. The median posterior spines of terga V–VII of *gaigei* are distinct, much larger than the obsolete ones of *sargentae*. The latter is a somewhat larger species than *gaigei*. The cerci do not differ from those of *cercalis* Caudell but are more slender than those of *tuberculatus* Caudell. With the exception of *gaigei* and *tuberculatus*, the straight hind tibia of *sargentae* separates it from most species of *Pristoceuthophilus*. *P. tuberculatus* differs in the specialization of the terga, as well as in the more robust cerci.

Since the original description in 1903, *Pristoceuthophilus* has been compared with *Ceuthophilus* and related genera by Caudell (1916) and Hubbell (1936). Only *arizonae* Hebard (1935) and *gaigei* have been described since 1916. The former differs from most other species in the smooth dorsum of the male abdomen. Karny (1937) published a list of species, but it appears fairly certain that several of the 11 species he recognized are synonyms. Hubbell (1932) has pointed out that the unique type of *rhoadsi* Rehn, the Mexican genotype, is immature, so it is possible that the other species now included in *Pristoceuthophilus* will eventually be found to represent a distinct genus.

The dorsal abdominal organ of the adult males of *gaigei* and *sargentae* is of a type unique in gryllacridids, so far as I am aware, and it establishes these species as two of the truly remarkable Nearctic Orthoptera. I propose to call this special organ *Hubbell's organ*[2] in recognition of the searching, comprehensive studies on Orthoptera conducted by T. H. Hubbell, who first described this structure in *gaigei*. Until further studies are made, we can only speculate concerning the function, if any, of Hubbell's organ. Perhaps it is the result of an evolutionary development which did not involve function, merely bizarre shape. It seems more likely, however, that glandular activity is associated with the organ, or that such has at one time been the case in the evolution of these insects, though only the functionless structure may now remain.

An unusual type of tergal specialization was

[2] Uvarov (1943) has applied the name *Krauss's organ* to a specialized structure of unknown function, though suspected of being sensory, found in both sexes of most grasshoppers of the subfamily Pamphaginae. The organ consists of a shallow chamber, covered by a sclerotized plate bearing tubercles or ridges, located on each side of the body in the ventro-anterior part of tergum II.

described by Hebard (1939) in *Salishella mirabilis,* a then new genus and species of Rhaphidophorinae from Pierce, Idaho. The male has two conspicuous transverse ridges on each of the basal 7 terga, one ridge median, the other at the posterior margin. It is barely possible that the origin of these ridges is akin to that of the specialization of *Pristoceuthophilus,* though the appearance of the two genera is quite different. Because of the likelihood that function may be associated with Hubbell's organ, the following information on the specialized physiology of certain Orthoptera is given with the hope that it will stimulate future students to make anatomical or life-history studies of *Pristoceuthophilus.*

NOTES ON THE SPECIAL GLANDS OF CERTAIN ORTHOPTERA

With the possible exception of mantids, all major families of Orthoptera contain certain species that possess specialized glands, usually on the thorax or abdomen, which serve either to attract the female at time of mating or to protect the insect from enemies by virtue of repugnatorial qualities. Among the best-known examples are the metanotal glands (glands of Hancock) of *Oecanthus* males (tree crickets) and the tergal glands of *Blattella* males (German cockroach and relatives), which attract females, and the prothoracic glands of *Anisomorpha* which enable this large walkingstick to eject a milky fluid that is extremely painful to the human eye (see Stewart, 1937, Maynard, 1889). A good general treatment of these glands, as found in Orthoptera, is that of Chopard (1938), who includes references to the more important of the fairly numerous papers dealing with special glands of Gryllacrididae and Tettigoniidae, as well as those of other families. Packard (1898) has discussed defensive glands of insects as a whole.

Males of at least two genera of Gryllacrididae (*Troglophilus, Hadenoecus*) have glands, ordinarily concealed beneath the body wall, which occasionally are everted and extruded between certain of the terga. In other genera (*Dolichopoda, Tachycines*) glands have been reported which are located in the region of intersegmental membranes of the terga and are attractive to females, though extrusion may not occur. Hancock (1905) reported an eversible gland which he found protruded between terga III and IV of the male of *Oecanthus.*

Seven or more genera of Tettigoniidae emit fluid from special openings in the body wall or from intersegmental membranes of the body or legs. Frequently the fluid is merely the blood of the insect, but in other cases glands secrete special fluids, though in either type defense appears to be the primary function in the majority of species. An example of what may be a combination of defense and sexual attraction is furnished by *Bradyporus multituberculatus* Fisch.-Waldh., a clumsy inhabitant of the uncultivated Russian steppes which somewhat resembles the Mormon cricket, *Anabrus,* in general habitus. Boldyrev (1928) has studied this species in detail. In both sexes there are slits borne on raised longitudinal ridges on the pronotum, metanotum and terga I-IX. Blood from within the body is ejected from these slits, sometimes to a distance of about 5 inches, but the ejection is definitely associated with the application of pressure to the sides of the body. This occurs when the insect is seized, and from males when females climb upon them during mating. While mating, the female often bites pieces from the hind margin of the pronotum, and, as the pressure starts the flow of blood, drinks it greedily.

The male of a Palearctic phaneropterine katydid, *Isophya acuminata* Brunn., has a specialized heart-shaped area in the middle of tergum I which bears short glandular hairs arranged in two broad longitudinal rows. The remaining surface of the tergum is smooth. Engelhardt (1915) has described the histology of this organ, which he believes is comparable to the metanotal glands of male *Oecanthus,* though of a much simpler structure. He says the female of *acuminata* applies her mouth to the glandular hairs during mating. The hairs are associated with secretory cells located in the body wall. There is no special reservoir for the fluid, which simply gathers among the hairs when glandular activity is stimulated.

So far as I know, no New World tettigoniid has been shown to have special glands or adaptations for emitting fluid

either as a means of defense or an attraction for the opposite sex. The products of secondary sexual glands in the perianal region or those of regurgitation are in another category.

It is the habit of many female Orthoptera to eat the spermatophore after it has been attached to her body by the male. Boldyrev (1914) has stressed the importance of protecting the spermatophore of Gryllidae and Tettigoniidae after mating until the spermatozoa have passed into the female's body. Substances produced by the male which are attractive to the female frequently serve to prevent her from consuming the spermatophore quickly. It is probable that in the long course of evolution an important impetus toward the successful development and survival of certain species has been supplied by the functions of the specialized male glands discussed in the foregoing paragraphs.

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ZOOLOGY.—*The southernmost* Natrix.[1]

RODGERS D. HAMILTON, University of Michigan. (Communicated by HERBERT FRIEDMANN.)

Dr. L. C. Stuart recently turned over to me for study two snakes of the genus *Natrix* from the U. S. National Museum collection, bearing the following data—Tenedores, Guatemala, Dr. Newton Miller, 1905. As this locality, if valid, would constitute the southernmost record on the continent for the genus, and as it is not far away from Dr. Hobart M. Smith's Mexican record (Proc. U. S. Nat. Mus. :93: 454. 1943) for *Natrix rhombifera rhombifera* from Emiliano Zapata, Tabasco, these snakes were examined carefully. Their distinctness from *rhombifera* was immediately apparent. Closer study reveals that they are probably intergrades between *Natrix sipedon sipedon* and *N. s. pleuralis*. Scale counts are as follows:

U.S.N.M. no.	*Dorsals*	*Ventrals*	*Caudals*
48963	23-23-17	140	tail broken
48964	23-25-19	138	73

The belly of no. 48963 has semilunar blotches, these becoming darker and breaking into speckles posteriorly. No. 48964 is spotted and speckled below, increasingly so posteriorly. Both snakes have 26 cross bands on the body. They thus seem to fall within the category of Mississippi Valley intergrades of *sipedon* and *pleuralis* as described by Clay (Copeia 1938: 173–182).

The possibilities are two. These snakes either were carried somehow to Guatemala and established themselves there, or some mishap has occurred in handling and labeling. Dr. Miller's reptiles were collected incidentally, while he was engaged in taking fishes, and the specimens were sent first to the University of Indiana and from there transshipped to the National Museum. The University, at Bloomington, Ind., is in the intergrading area of *N. s. sipedon* and *N. s. pleuralis* (Minton, Amer. Midl. Nat. 32: 438–477. 1944), and might be expected to have had specimens of this type in its collections. It seems very likely, therefore, that some sort of accident occurred at the University, resulting in the inclusion of these snakes in the National Museum shipment, and that this accounts for the otherwise astonishing occurrence of this animal so far south of its hitherto known range. Although it is not improbable that *Natrix* will be found in Guatemala, I believe that these snakes must be withheld from the faunal list of that country and that when and if *Natrix* is found to occur there it will not be of this species. Dr. Hobart Smith's record therefore remains as the southernmost record for the genus on this continent.

[1] Received August 7, 1947.

PROCEEDINGS OF THE ACADEMY

49TH ANNUAL MEETING

The 49th annual meeting of the Academy, held in the Auditorium of the Cosmos Club, January 16, 1947, after the 346th meeting of the Academy, was called to order at 9:45 P.M. by the President, HUGH L. DRYDEN, with 32 persons in attendance.

The minutes of the 48th annual meeting were approved as published in the JOURNAL 36: 170–176. 1946.

The reports of several officers and of the Committees of Auditors and Tellers were read and accepted. These reports are recorded at the end of the minutes.

After the acceptance of the report of the Committee of Tellers, the President declared the following duly elected to the given offices.

WALDO L. SCHMITT, *President,*
C. LEWIS GAZIN, *Secretary,*
HOWARD S. RAPPLEYE, *Treasurer,*
WILLIAM W. DIEHL and F. G. BRICKWEDDE, *Board of Managers to January 1950.*

The Secretary presented for the Affiliated Societies their nominations for Vice-Presidents of the Academy as follows:

Philosophical Society of Washington—FRED L. MOHLER
Anthropological Society of Washington—FRANK M. SETZLER

Biological Society of Washington—JOSEPH S. WADE
Chemical Society of Washington—IRL C. SCHOONOVER
Entomological Society of Washington—CARL F. W. MUESEBECK
National Geographic Society—ALEXANDER WETMORE
Geological Society of Washington—WILLIAM W. RUBEY
Medical Society of the District of Columbia—FREDERICK O. COE
Columbia Historical Society—GILBERT GROSVENOR
Botanical Society of Washington—L. EDWIN YOCUM
Washington Section of the Society of American Foresters—WILLIAM A. DAYTON
Washington Society of Engineers—CLIFFORD A. BETTS
Washington Section of the American Institute of Electrical Engineers—FRANCIS B. SILSBEE
Washington Section of the American Society of Mechanical Engineers—MARTIN A. MASON
Helminthological Society of Washington—AUREL O. FOSTER
Washington Branch of the Society of American Bacteriologists—CHESTER W. EMMONS
Washington Post of the Society of American Military Engineers—CLEMENT L. GARNER
Washington Section of the Institute of Radio Engineers—HERBERT GROVE DORSEY
Washington Section of the American Society of Civil Engineers—OWEN B. FRENCH

The Secretary was instructed by the members present to cast a unanimous ballot for these nominees.

The President, HUGH L. DRYDEN, announced the recipients of the Academy's Awards for Scientific Achievement for 1946 as follows:

In the Biological Sciences, WALDO RUDOLPH WEDEL, United States National Museum, in recognition of his distinguished service in contributing to the knowledge of the prehistory of human ecology in the central Great Plains.

In the Engineering Sciences, MARTIN ALEXANDER MASON, Beach Erosion Board, in recognition of his distinguished service in erosion studies leading to successful beach invasions by allied armed forces during the war.

In the Physical Sciences, GEORGE WASHINGTON IRVING, JR., Bureau of Agricultural and Industrial Chemistry, in recognition of his distinguished service in biochemistry and especially for work on antibiotics in tomato plants.

The Retiring President, HUGH L. DRYDEN, appointed Past Presidents HARVEY L. CURTIS and JOHN E. GRAF to escort the incoming President, WALDO L. SCHMITT, to the chair. Dr. SCHMITT adjourned the meeting at 10:30 P.M.

The following reports were presented at the meeting:

REPORT OF THE SECRETARY

During the Academy year, January 18, 1946, to January 16, 1947, 36 persons were elected to membership, 29 resident and 7 nonresident. Of these, 11 resident and 1 nonresident qualified for membership, and 6 resident accepted membership but have not yet qualified by payment of dues. Seventeen persons, 11 resident and 6 nonresident, elected to membership on January 13, 1947, have not yet been notified of their election. Eight resident members and one nonresident member elected to membership in the preceding Academy year qualified during the present Academy year just ending. The new members who qualified in the Academy year 1946 were distributed among the various sciences as follows: 6 in botany, 4 each in chemistry and physics, 2 each in anthropology and entomology, and 1 each in geology, mathematics, and medicine.

Six resident and 5 nonresident members, having retired from the remunerative practice of their professions, were placed on the retired list of members to enjoy all the privileges of active membership without further payment of dues. Two resident and two nonresident members resigned in good standing. One nonresident member was dropped for nonpayment of dues.

The deaths of the following members were reported to the Secretary:

FRANK LEECH, Washington, D. C., in February 1942.
CHARLES W. DABNEY, Cincinnati, Ohio, on June 15, 1945.
GLENN L. PARKER, Washington, D. C., on February 12, 1946.
ALBERT C. HUNTER, Washington, D. C., on April 13, 1946.
GIFFORD PINCHOT, Milford, Pa., on October 4, 1946.
GERALD F. LOUGHLIN, Washington, D. C., on October 22, 1946.

Mr. PINCHOT was the last surviving patron of the Academy.

On January 16, 1947, the status of membership was as follows:

	Regular	Retired	Honorary	Patron	Total
Resident.....	449	39	2	0	490
Nonresident...	152	28	16	0	196
Total.....	601	67	18	0	686

The net changes in membership during the past year are as follows:

	Regular	Retired	Honorary	Patron	Total
Resident.....	+17	+2	0	0	19
Nonresident...	− 4	+2	0	−1	− 3
Total.....	+13	+4		−1	+16

During the Academy year 1946 the Board of Managers held 6 meetings, with an average attendance of 20 persons. The following important matters were considered by the Board:

1. *The first A.A.A.S. grants-in-aid to be awarded by the Washington Academy of Sciences.*—These first grants were made to ANGUS MACIVOR GRIFFIN, associate professor in the Department of Bacteriology, Hygiene, and Preventive Medicine, George Washington School of Medicine, and to R. M. TATUM, U. S. Naval Academy, Annapolis, Md. The grant of $429 to Dr. GRIFFIN was for the purchase of equipment needed in making phase microscopy observations of entozoic Protozoa to further his researches in the borderline between the intestinal Protozoa and bacteria. The grant of $50 to Mr. TATUM was to aid in completing a comprehensive survey of Indian petroglyphs throughout the United States. The Board of Managers requested Dr. GRIFFIN and Mr. TATUM to submit to the Academy reports on their work in the form of papers suitable for consideration by the Editors for publication in the JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES. The Board feels some notice of work supported by the grants-in-aid should be taken by the JOURNAL even if it is only an abstract.

2. *The increase in dues of resident members from $5 to $6.*—The George Banta Publishing Co., printer of the JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES, acting within its rights, canceled, effective June 1, 1946, its contract with the Academy in force since January 2, 1942, for the printing and mailing of the JOURNAL. Thereupon, the George Banta Publishing Co. proffered the Academy a new contract with increased costs to the Academy. This was presumably the result of increased costs for labor and materials. The Senior Editor of the JOURNAL after consulting the Board of Managers accepted the new contract, inasmuch as it appeared impossible to obtain better prices from any other company for the same quality of material and work.

The cost of printing and mailing the JOURNAL under the new contract is about 25 percent, or $800 per annum, greater than under the old contract. The total cost to the Academy of publishing the JOURNAL on the basis of the new contract, maintaining former standards of size and quality, is about $4,000 per annum. This does not include direct charges to authors. The total income of the Academy in 1945 exclusive of charges to authors was $4,901.16, of which $2,776.25 was derived as dues from members, $1,099.25 from returns on invested funds of the Academy, $925.54 from non-member subscriptions to the JOURNAL, $100.12 from sale of miscellaneous back numbers of the JOURNAL.

The Board of Managers, at the meeting on May 13, 1946, voted the following measures to increase the income of the Academy:

1. To raise the price of annual nonmember subscriptions of the JOURNAL from $6 to $7.50. In May the JOURNAL had 185 nonmember subscriptions.

2. To raise the price of back numbers of the JOURNAL from $6 per volume to $10 per volume for volumes 1 to 15, $8 per volume for volumes 16 to 22 and $7.50 per volume for volumes 23 to the current issue. The costs of separate numbers are increased in proportion. At present the Academy has only 3 complete sets of the JOURNAL for sale. In addition to these there are only 11 other sets complete from volume 11 to the current issue.

3. To submit to the members of the Academy an amendment to the bylaws of the Academy raising the annual dues of resident members from $5 to $6. Academy members voted 157 to 38 for adoption of this amendment.

During the Academy year, eight meetings of the Academy were held as follows, beginning with the 339th meeting and ending with the 346th meeting:

On February 21, 1946, JOHN E. GRAF, as retiring president presented an address entitled *National responsibility for research* (published in this JOURNAL **36**: 101–110. 1946).

On March 21, 1946, the 1945 Academy Awards for Scientific Achievement were presented to HENRY K. TOWNES, Bureau of En-

tomology and Plant Quarantine, for work in the biological sciences; to KENNETH L. SHERMAN, Department of Terrestrial Magnetism, for work in the engineering sciences; and to ROBERT SIMHA, National Bureau of Standards, for work in the physical sciences.

On April 18, 1946, V. K. ZWORYKIN, director of the Electronic Research Laboratory, Radio Corporation of America, Princeton, N. J., addressed the Academy on *Recent developments in television.*

On May 16, 1946, IGOR I. SIKORSKY, engineering manager of Sikorsky Aircraft Division, United Aircraft Corporation, addressed the Academy on *The helicopter and its place in modern transportation.*

On October 17, 1946, DEAN B. COWIE, Department of Terrestrial Magnetism, addressed the Academy on *Radioactive tracer studies in medicine and biology.*

On November 21, 1946, Capt. CHARLES BITTINGER, U.S.N.R., addressed the Academy on *Camouflage, 1917–1918 and 1941–1945.*

On December 19, 1946, LEONARD P. SCHULTZ and J. P. E. MORRISON, United States National Museum, addressed the Academy on *Biology of Bikini and of adjoining atolls.*

On January 16, 1947, WALDO R. WEDEL, United States National Museum, addressed the Academy on *Archeology and the Missouri River Basin development program.*

The April and May meetings were held in the Auditorium of the United States National Museum. All other meetings were held in the Assembly Hall of the Cosmos Club.

F. G. BRICKWEDDE, *Secretary.*

REPORT OF THE TREASURER

CASH RECEIPTS AND DISBURSEMENTS

RECEIPTS		
From dues, 1944	$ 5.00	
From dues, 1945	100.00	
From dues, 1946	2,760.00	
From dues, 1947	26.00	$ 2,891.00
From JOURNAL, Subscriptions, 1942	$ 7.40	
From JOURNAL, Subscriptions, 1943	11.40	
From JOURNAL, Subscriptions, 1944	12.90	
From JOURNAL, Subscriptions, 1945	45.53	
From JOURNAL, Subscriptions, 1946	760.10	
From JOURNAL, Subscriptions, 1947	510.18	
From JOURNAL, Subscriptions, 1948	5.10	1,352.61
From JOURNAL, Reprints, 1945	$ 264.95	
From JOURNAL, Reprints, 1946	342.40	607.35
From JOURNAL, Sales		798.20
From JOURNAL, Overpayment on Sales		0.20
From Directory, 32nd Edition (1941)		0.50
From Interest & Dividends		990.00
Total Receipts		$ 6,639.86
Cash Balance, Jan. 1, 1946		3,462.78
Total to be accounted for		$10,102.64

DISBURSEMENTS:	*1945*	*1946*	*Total*
For Secretary's Office	$ 4.50	$ 208.61	$ 213.11
For Treasurer's Office	39.25	176.10	215.35
For Custodian & Subscr. Mgr.	14.65	29.59	44.24
For JOURNAL, Printing & Mailing	249.86	3,014.58	3,264.44
For JOURNAL—Illustrations	22.22	373.41	395.63
For JOURNAL—Reprints	100.55	459.48	560.00
For JOURNAL Office—Clerk	20.00	220.00	240.03
For JOURNAL Office—Postage, Binding, & Misc.	2.57	38.16	40.73
For Meetings Committee	95.30	238.60	333.90

For Debit Memos & Refunds:			
For Refund Dues 1946, F. L. Hess		5.00	5.00
For Check (Hann) returned for lack of funds		5.00	5.00
For Exchange on Puerto Rican check		0.35	0.35
For Exchange on Canadian check		0.61	0.61
Total Disbursements	$548.90	$4,769.49	$ 5,318.39
Cash Balance, Dec. 31, 1946			4,784.25
Total			$10,102.64

RECONCILIATION OF BANK BALANCE

Balance as per cash book, Dec. 31, 1946			$ 4,784.25
Balance as per Amer. Sec. & Trust Co.			
Statement of Dec. 31, 1946		$4,341.71	
Receipts not deposited		577.82	
Total		$4,919.53	
Checks outstanding, not cashed			
No. 1018	$ 5.41		
No. 1140	5.00		
No. 1144	85.87		
No. 1145	39.00	135.28	$ 4,784.25

INVESTMENTS

Washington Sanitary Improvement Co. (stock)			
Certificate No. 434—100 shares at $10		$1,000.00	
Certificate No. 435—100 shares at $10		1,000.00	
Certificate No. 527— 8 shares at $10		80.00	
Certificate No. 539— 1 share at $10		10.00	
Certificate No. 582—200 shares at $10		2,000.00	$ 4,090.00
Potomac Electric Power Co.			
20 shares, 6% preferred stock—cost			2,247.50
City of New York—3% (Transit Unification) (Due—June 1, 1980)			
Certificate No. D 20186		500.00	
Certificate No. C 71038		100.00	
Certificate No. C 71039		100.00	
Certificate No. C 71040		100.00	800.00
Chicago Railways			
Bond No. 1027—5% Registered for $1,000.00			
Due Feb. 1927—$250.00 paid—Bal.			750.00
First Federal Savings & Loan Assn.			
Certificate No. I— 914		$4,000.00	
Certificate No. I—1063		1,000.00	5,000.00
Northwestern Fed. Savings & Loan Assn.			
Certificate No. 1380		$4,500.00	
Certificate No. 1441		500.00	5,000.00
United States Government			
Series G Bonds—No. M 332990 G (Jan. 1942)		$1,000.00	
M 332991 G (Jan. 1942)		1,000.00	
M 332992 G (Jan. 1942)		1,000.00	
M 332993 G (Jan. 1942)		1,000.00	
M 1808741 G (Oct. 1943)		1,000.00	
M 2226088 G (Feb. 1944)		1,000.00	
M 2982748 G (Oct. 1944)		1,000.00	
M 4126041 G (Oct. 1945)		1,000.00	$ 8,000.00

American Security & Trust Co.		
Savings Account		46.87
Total		$25,934.37
Cash Book Balance		4,784.25
Total		$30,718.62
Total Assets Dec. 31, 1945	$29,397.15	
Total Assets Dec. 31, 1946	30,718.62	
Increase	$ 1,321.47	

At the time this report was written (not as of December 31, 1946) there were:
19 members in arrears for 1946
14 members in arrears for 1945 and 1946
2 members in arrears for 1944, 1945 and 1946
6 members in arrears for 1943, 1944, 1945 and 1946
1 member in arrears for 1942, 1943, 1944, 1945 and 1946

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HOWARD S. RAPPLEYE, *Treasurer.*

REPORT OF THE AUDITING COMMITTEE

The accounts of the Treasurer of the Washington Academy of Sciences for the year 1946 were examined by your auditing committee on January 14, 1947.

The Treasurer's report was checked and found to be in agreement with the records. All disbursements had been previously authorized and are supported by vouchers or canceled checks. The securities of the Society were inspected and found to be in agreement with the list given in the report and to have all coupons attached that are not yet due.

The Treasurer deserves the highest commendation for the neat, orderly, and conscientious manner in which he has continued to keep and preserve the financial records of the Academy.

H. E. MCCOMB, *Chairman.*
J. H. TAYLOR.
SAMUEL LEVY.

REPORT OF THE BOARD OF EDITORS

Volume 36 of the JOURNAL shows a continuation of the climb back to the size enjoyed during prewar years. Its 12 issues contained 432 pages, 24 pages more than last year, and the largest since volume 31 (1941), which had 528 pages.

In other ways, too, last year's volume showed a continuing trend toward improvement. Its 65 papers were divided among the various categories as follows:

Sciences	Number of papers 1946	Number of pages 1946	Percentages by pages 1946	Number of pages 1945	Percentages by pages 1945
Biological	40	178.8	41.4	218.0	53.4
Physical	8	78.5	18.2	28.7	7.1
Anthropological	12	114.0	26.4	97.3	23.8
Geological	4	24.2	5.6	22.0	5.4
Other	1	9.5	2.2	3.3	0.8
Obituaries, Proceedings, Notices		23.0	5.3	34.7	8.5
Index		4.0	0.9	4.0	1.0
Totals	65	432.0	100.0	408.0	100.0

These figures show a better balance between the various categories than in the last three years. An increase in papers in the physical sciences is notable, but there still is, however, a noticeable lack of papers in the physical, and especially in the geological sciences, which it is hoped will be at least partly remedied next year.

Two papers in the physical sciences were published in the French language by scientists at the University of Liége, Belgium. We hope that more papers from foreign authors will be forthcoming, not only from Europe but also from the countries of Latin America.

This volume contains the addresses of the retiring presidents of the Academy, the Chemical Society, and the Philosophical Society, 1943 and 1945.

In one aspect a decline was shown in this volume. Of the 65 papers published in the JOURNAL, only 26, or 40 percent, were submitted by members of the Academy, the lowest percentage in many years. This is not a healthy condition, and it is sincerely to be hoped that more members will make an earnest effort to send in worthwhile papers to the JOURNAL.

No significant changes in the numbers of papers published and illustrations used were noted.

The outstanding event in the affairs of the JOURNAL was the notification by the printer of an increase of 25 percent in the cost of the printing, commencing with the June number. Considerable thought was given to the matter, and a meeting was held of the Board of Editors with the Executive Committee. As the rise in cost of materials and labor was undoubtedly felt equally throughout the industry, it was decided that an attempt to seek a more advantageous contract with another establishment would be fruitless. For this reason, and also in view of our long and cordial relationship with the George Banta Publishing Co., it was decided to accept the new contract.

To meet this increase, the Board of Managers authorized an additional appropriation equal to 25% of 7/12 of the annual appropriation for the year (to cover the increased cost of the issues from June to December, inclusive).

The Board of Managers appropriated to the editors for printing, illustrating, and mailing the JOURNAL last year $3,666.67 ($3,200 on original appropriation and $666.67 additional appropriation); for clerical assistance $240; and for postage and incidentals $50.00, a total of $3,956.67. Of this, the $240 for clerical assistance was expended in full, and the postage and incidentals cost $39.96. The total cost of the printing bills was $4,339.27. From this is to be subtracted $781.83, the amount charged to authors for reprints, excess illustrations, and excess typesetting charges. This brings the net cost to the Academy of printing the JOURNAL to $3,557.44, leaving a balance of about $100 to be turned back to the Treasurer. Of the appropriation for postage and incidentals, $10.14 was unexpended.

The editors feel that in the coming years the JOURNAL should attempt gradually to regain its former size of over 500 pages. We feel that for the present this is more important than reducing the present charges to authors for reprints and for excess illustrations, tabular material, and the like. To reach this goal, however, more first-class papers are needed, and in this the JOURNAL must have the whole-hearted support of all the members of the Academy, especially from those academicians in the physical and geological sciences. An ultimate return to a policy of allowing a modest number of free reprints to authors would attract more good papers, and, in the opinion of the editors, seems a crucial policy for a general journal.

It is felt that little saving would be realized by publishing only six issues a year and doubling the size of each number. The JOURNAL is one scientific medium that can promise fairly prompt publication of papers, and such a move would be a step backward from our outstanding position among scientists.

For the coming year we therefore recommend that for printing, illustrating, and mailing the JOURNAL the minimum sum of $4,000 be appropriated; this is equal to last year's appropriation plus the 25 percent increase in costs. We also recommend that the appropriation for clerical assistance be increased from $240 to $300. This rise is consistent with the present economic situation, and during recent years the editorial assistant, Mr. PAUL H. OEHSER, has devoted more and more time to the JOURNAL, enabling the Board of Editors to concentrate on selection and revision of papers and on careful proofreading. His willing co-

operation in giving the JOURNAL the benefit of his experience in editorial work has been indispensable.

The Editors also acknowledge with thanks the assistance of the Associate Editors, and all others who have assisted them in any way. We wish also to mention our gratitude to Mr. IRWIN H. WENSINK, the local representative of the George Banta Publishing Co., whose ever-ready willingness to assist the Editors in ironing out occasional problems is gratefully appreciated.

HARALD A. REHDER.
WILLIAM N. FENTON.
JAMES I. HOFFMAN.

REPORT OF THE CUSTODIAN AND SUBSCRIPTION MANAGER OF PUBLICATIONS

SUBSCRIPTIONS:

Nonmember subscriptions in the United States	119
Nonmember subscriptions in foreign countries	66
Subscriptions at reduced rates:	
Geological Society of Washington at $1.50	22
Others at $2.50	2
Total	209

INVENTORY OF STOCKS AS OF DEC. 31, 1946:

Reserve Sets of the JOURNAL:		
Bound Volumes 1–29 and unbound Volumes 30–36		1 set
Unbound Volumes 1–36		2 sets
Unbound Volumes 11–36		6 sets
Unbound Volumes 16–36		11 sets
Miscellaneous numbers of the JOURNAL	19,222	
Total numbers in the Reserve Sets	7,842	
Grand total of back numbers	27,064	
Proceedings of the Washington Academy of Sciences:		
Volumes 1–13, inclusive (1899–1911)		50 sets

During the year several important changes were made by the Board of Managers concerning the office of the Custodian of Publications:

At its 401st meeting, April 15, 1946, the Board voted to reconsider previous instructions in regard to the sale of complete sets of the JOURNAL. The Board voted to instruct the Custodian and Subscription Manager of Publications to sell complete sets of the JOURNAL only to libraries accessible to the public. This restriction was immediately put into effect by a printed statement on the back of the front cover of the March 15 issue of the JOURNAL.

At its 402d meeting, May 13, 1946, the Board voted to raise the sale price of back numbers of the JOURNAL from Vol. 1 through Vol. 15 to $10 per volume; Vol. 16 through Vol. 22, $8 per volume; and Vol. 23 to current issues, $7.50 per volume; with changes in the prices of *separate numbers* in line with the increases in the prices of the complete volumes, the changes in prices to take effect as soon as the revised schedule of prices could be printed on the back of the cover page of the JOURNAL. These changes were printed in the June 15, 1946 (Vol. 36, No. 6) issue of the JOURNAL, together with the corresponding change of prices for the individual numbers. It was also voted to remove all volumes and numbers of Vol. 1 through Vol. 10 from sale in order to preserve these early volumes for the making of additional complete sets.

At the 402d meeting it was also voted to raise the price of annual subscription from $6 to $7.50, effective January 1, 1947. All subscribers have been notified, and this action has been put into effect.

The price of individual back numbers has been increased to correspond with the prices per volume as voted by the Board. Instead of a flat rate of 50 cents per number, the following prices are quoted:

Vol. 1 to Vol. 10, incl.—not available except in complete sets.
Vol. 11 to Vol. 15, incl. (21 numbers per volume)—$0.70 per no.
Vol. 16 to Vol. 22, incl. (21 numbers per volume)—$0.60 per no.
Vol. 23 to current vol. (12 numbers per volume)—$0.90 per no.
Complete sets, to libraries only (Vol. 1 to Vol. 36, incl.), $311.

Upon receipt of the semi-annual inventory of volumes and numbers stored at Menasha, Wis., we were amazed to learn that owing to an increase in our memberships and subscriptions and shortage of paper we had exhausted all copies of No. 1 of Vol. 36 of the JOURNAL, and were below a safe margin of Nos. 2–7, inclusive. Such a shortage could prevent the sale of a complete set, especially since all volumes after Vol. 16 had been held at 20 complete sets. This matter was brought to the attention of the Board of Managers, who authorized the Custodian to appeal to the members not wishing to retain copies of these numbers of Vol. 36 to donate them to the Academy. Several members quickly responded, giving us 30 copies of the missing No. 1 of Vol. 36 and a comparable amount of the other numbers. The Editors in turn have increased the number of copies to be printed.

SALES AND EXPENDITURES:

During January 1946 one complete set of the JOURNAL (Vol. 1–Vol. 35) was sold to the Library of the Denver Art Museum, Denver, Colo. Throughout the year a considerable increase in the sales of back numbers was realized. Approximately 550 numbers were sold as compared to 200 the previous year.

Sales

1 Reserve Set	$200.50
Net sales of miscellaneous numbers	387.70
Total sales	$588.20

Expenditures

Express charges for shipment of Reserve Set to Denver, Colo.	$ 10.44
Postage and office expenses	14.74
Total expenses	$ 25.18
1946 Budgetary allotment	$100.00
Expenditures for 1946	25.18
Balance	$ 74.82
Net gain for the year 1946	$563.02

F. M. SETZLER, *Custodian and Subscription Manager of Publications.*

REPORT OF THE COMMITTEE OF TELLERS

A total of 262 envelopes were delivered to the Secretary. The count of valid ballots showed the following officers elected:

President, WALDO L. SCHMITT,
Secretary, C. LEWIS GAZIN,
Treasurer, HOWARD S. RAPPLEYE
Board of Managers to January 1950, WILLIAM W. DIEHL and F. G. BRICKWEDDE.

K. L. SHERMAN, *Chairman.*
RAYMOND DAVIS.
FRANK NEUMANN.

Submitted by F. G. BRICKWEDDE, *Secretary.*

412TH MEETING OF BOARD OF MANAGERS

The 412th meeting of the Board of Managers, held in the Cosmos Club, November 24, 1947, was called to order at 8 p.m. by the President, Dr. W. L. SCHMITT. Others present were: H. S. RAPPLEYE, N. R. SMITH, H. B. COLLINS, Jr., W. W. DIEHL, F. L. MOHLER, F. M. SETZLER, W. W. RUBEY, L. E. YOCUM, H. G. DORSEY, C. L. GAZIN, and, by invitation, G. P. WALTON, A. STONE, F. THONE, and H. E. MCCOMB.

The President announced the appointment of an Auditing Committee: F. D. ROSSINI, Chairman, A. H. CLARK, and H. E. MCCOMB.

The Chairman of the Committee on Meetings, G. P. WALTON discussed the manner of introducing the recipients of Academy Awards for Scientific Achievement and suggested that three conditions be imposed: (1) The recipient shall be introduced by an intimate professional associate, the introduction to be limited to 5 minutes. (2) The recipient shall be given 20 minutes to explain the work for which the award was given. (3) If a recipient cannot be present to receive his award, the sponsor for his candidacy shall be invited to accept it for him. The Board voted that these suggestions be complied with.

The Chairman of the Committee on Membership, W. W. DIEHL, presented 18 nominations for resident membership and 2 for nonresident membership. The Board recommended that the names of all Nobel prize winners who have spoken before the Academy be considered individually by the membership committee for honorary membership.

The Chairman of the Nominating Committee, F. L. MOHLER, reported that the following had been nominated for the offices to be filled by balloting by members in December: For President, F. D. ROSSINI; for Secretary, C. L. GAZIN; for Treasurer, H. S. RAPPLEYE; for the Board of Managers to serve from January 1948 to January 1951, E. W. PRICE, W. N. FENTON, F. C. KRACEK, F. M. DEFANDORF.

On his recommendation, the Treasurer, H. S. RAPPLEYE, was authorized to present for redemption a $1,000 Chicago City Railways Co. bond which was being called.

The President reported on the progress of the illustrated "Red Book" in preparation for printing.

The Academy's representative on the Joint Committee on Press Relations (with the D.C. Council of Engineering and Architectural Societies), Dr. THONE, reported the success of the Committee in obtaining the cooperation of four Washington newspaper editors in publishing a weekly calendar of scientific and technical meetings. He urged that information regarding the open meetings be submitted to the Committee on cards provided and that these be in the hands of the Committee by noon Wednesday of the week preceding the meeting.

The meeting adjourned at 9:45 p.m.

C. L. GAZIN, *Secretary.*

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